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Aggregate Resources Inventory Paper 90

# AGGREGATE RESOURCES INVENTORY OF THE EASTERN PART OF THE CITY OF TIMMINS

## Cochrane District

## NORTHERN ONTARIO

by
Staff of the Engineering and Terrain Geology Section
Ontario Geological Survey

1983

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This report was prepared by: Staff of the Aggregate Assessment Office, Engineering and Terrain Geology Section of the Ontario Geological Survey, Ontario Ministry of Natural Resources, 77 Grenville Street, Toronto, M5S 1B3, Telephone (416) 965-1182.

Project Supervisor: Dale W. Scott
Text Prepared by: G. Jones
Compilation and Drafting by: Staff of the Aggregate Assessment Office

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## ABSTRACT

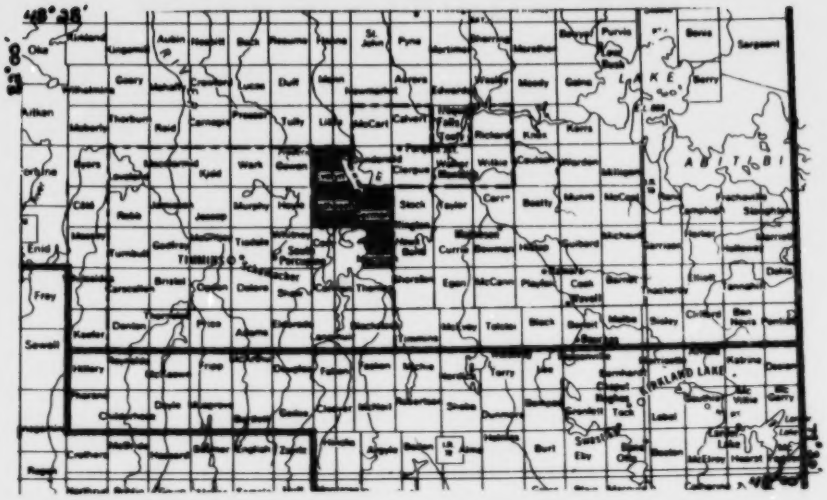



Figure 1 - Key Map Showing Location of the Eastern Part of the City of Timmins, Scale 1:1 800 000.

This report includes both an inventory and evaluation of sand and gravel as well as bedrock resources for four townships and part of a fifth in the eastern part of the City of Timmins. The report is based on previous studies in the area and a detailed field assessment undertaken in the summer of 1981 by a two-man field party funded by the Ontario Ministry of Northern Affairs.

In the project area, four areas containing significant amounts of sand and gravel have been selected for possible resource protection at the primary level of significance. Selected Sand and Gravel Resource Areas occupy 640 acres (260 ha). An estimated 470 acres (190 ha) are currently available for extraction, containing resources of approximately 53 million tons (48 million tonnes). The parts of the selected areas which are available for extraction, represent 2 percent of the total area occupied by sand and gravel deposits in the study area and 4 percent of the total resource tonnage.

Selected Sand and Gravel Resource Area 1 is an esker deposit located along Gibson Lake Road in Macklem Township. The Area forms the most important natural aggregate deposit in the study area and contains an estimated 23 million tons (21 million tonnes) of sand and gravel.

Selected Sand and Gravel Resource Areas 2, 3 and 4 are also esker deposits located in the project area. These Areas contain an estimated 30 million tons (27 million tonnes) of sand and gravel.

The project area has possible sand and gravel resources which should be sufficient for local needs for a considerable period of time. However, the area has limited possible resources of good-quality crushable gravel. Care should be taken to ensure the continuing availability of as much of the remaining resources as possible.

The project area is underlain predominantly by metavolcanic and metasedimentary rocks of the Precambrian Shield. No bedrock has been selected for resource protection as only a small proportion of the bedrock lies below less than 25 feet (8 m) of overburden.

Selected Resource Areas are not intended to be permanent, single land use units which must be incorporated in an official planning document. They represent areas in which a major resource is known to exist. Such Resource Areas may be reserved wholly or partially for extractive development and/or resource protection within the context of the official plan.

# AGGREGATE RESOURCES INVENTORY OF THE EASTERN PART OF THE CITY OF TIMMINS[1]

BY
STAFF OF THE ENGINEERING
AND TERRAIN GEOLOGY SECTION

## INTRODUCTION

Mineral aggregates, which include bedrock-derived crushed stone as well as naturally formed sand and gravel, constitute the major raw material in Ontario's road-building and construction industries. Very large amounts of these materials are used each year throughout the Province. For example, in 1980, the total tonnage of mineral aggregates extracted was 171 million tons (155 million tonnes), greater than that of any other metallic or nonmetallic commodity mined in the Province (Ontario Ministry of Natural Resources 1981).

Although mineral aggregate deposits are plentiful in Ontario, they are fixed-location, nonrenewable resources which can be exploited only in those areas where they occur. Mineral aggregates are characterized by their high bulk and low unit value so that the economic value of a deposit is a function of its proximity to a market area as well as its quality and size. The potential for extractive development is usually greatest in urban fringe areas where land use competition is extreme. For these reasons the availability of adequate resources for future development is now being threatened in some areas.

Comprehensive planning and resource management strategies are required to make the best use of available resources, especially in those areas experiencing rapid development. Such strategies must be based on a sound knowledge of the total mineral aggregate resource base at both local and regional levels. The purpose of the Aggregate Resources Inventory is to provide the basic geological information required to include potential mineral aggregate resource areas in planning strategies and official plans. The reports should form the basis for discussion on those areas best suited for possible extraction. The aim is to assist decision-makers in protecting the public well-being by ensuring that adequate resources of mineral aggregate remain available for future use.

This report is a technical background document, based for the most part on geological information and interpretation. It has been designed as a component of the total planning considerations, to ensure the best use of a municipality's resources.

The report includes an assessment of sand, gravel and crushed bedrock. The most recent information available has been used to prepare the report. As new information becomes available, revisions may be necessary.

[1]Manuscript accepted for publication by Chief Engineering and Terrain Geology Section, December 17, 1982.
This paper is published with the permission of E.G. Pye, Director, Ontario Geological Survey.

# PART I - INVENTORY METHODS

## FIELD AND OFFICE METHODS

The methods used to prepare the report primarily involve the interpretation of published geological data such as bedrock and surficial geology maps and reports (see References) as well as field examination of potential resource areas. Field methods included the examination of natural and man-made exposures of granular material. Most observations were made at quarries and sand and gravel pits located from records held by the Ontario Ministry of Transportation and Communications, the Ontario Geological Survey, and by Regional and District Offices of the Ontario Ministry of Natural Resources. Observations made at pit sites included estimates of the total face height and the proportion of gravel-and sand-sized fragments in the deposit. Observations were also made of the shape and lithology of the particles. These characteristics are important in estimating the quality and quantity of the aggregate. In areas of limited exposure, test pitting, soil probing and hand-augering techniques were used to assess subsurface materials. Airphotos at various scales were used to determine the continuity of deposits, especially in areas where information is limited.

Deposits with potential for further extractive development or those where existing data are scarce, were studied in greater detail. Representative layers in these deposits were sampled in 25- to 100-pound (11- to 45-kg) units from existing pit faces or from test pits dug by backhoe. The samples were analysed for grain size distribution and in some cases for petrographic assesmblage. Analyses were performed in the laboratories of the Soils and Aggregates Section, Engineering Materials Office, Ontario Ministry of Transportation and Communications. In areas of limited subsurface exposure, drilling using a powered hollow stem auger was undertaken. The sediments revealed in these test holes are described in Table 7. The symbols for and locations of sample and test hole sites are noted on Map 1.

In the office, the field data were supplemented by pit information on file with the Soils and Aggregate Section of the Ontario Ministry of Transportation and Communications. Data contained in these files include field estimates of the depth, composition and "workability" of deposits as well as laboratory analyses of the physical properties and chemical suitability of the aggregate. Information concerning the development history of the pits and acceptable uses of the aggregate is also recorded. The locations of additional sources were obtained from records held by Regional and District Offices of the Ontario Ministry of Natural Resources. The cooperation of the above named groups in the compilation of inventory data is gratefully acknowledged.

Water well records, held by the Ontario Ministry of the Environment, were used in some areas to corroborate thickness estimates or to indicate the presence of buried granular material. These records were used only in conjunction with other evidence. Topographic maps of the National Topographic System, at a scale of 1:50 000, were used as a compilation base for the field and office data. The information was then transferred to a base map, also at a scale of 1:50 000, prepared by the Cartography Section of the Lands and Waters Group, Ontario Ministry of Natural Resources, for presentation in the report.

## RESOURCE TONNAGE CALCULATION TECHNIQUES

### SAND AND GRAVEL RESOURCES

Once the interpretative boundaries of the aggregate units have been drawn, quantitative estimates of the possible resources available can be made. Generally, the volume of a deposit can be calculated if its areal extent and average thickness are known or can be estimated. The computation methods used are as follows. First, the area of the deposit, as outlined on the final base map, is calculated in acres. The thickness values used are an approximation of the deposit thickness, based on the face heights of pits developed in the deposit or on subsurface data such as test holes and water well logs. Original tonnage values can then be calculated by multiplying the volume of the deposit by 2500 (the density factor). This factor is approximately the number of tons in a one-foot (0.3-m) thick layer of sand and gravel, one acre (0.4 ha) in extent,

assuming an average density of 110 pounds per cubic foot (1766 kg per cubic metre).

*Tonnage = Area x Thickness x Density Factor*

Tonnage calculated in this manner must be considered only as an estimate. Furthermore, such tonnages represent amounts that existed prior to any extraction of material (i.e. original tonnage) (Table 1, Column 4).

The Selected Sand and Gravel Resource Areas in Table 3 are calculated in the following way. Two successive subtractions are made from the total area. Column 3 accounts for the number of acres unavailable due to the presence of permanent cultural features and their associated setback requirements. Column 4 accounts for those areas that have previously been extracted. The remaining figure is the area of the deposit currently available for extraction (Column 5). The available area is then multiplied by the estimated deposit thickness and the density factor (Column 5 x Column 6 x 2500) to give an estimate of the sand and gravel tonnage (Column 7) presently available for extractive development and/or resource protection.

Reserve estimates are calculated for deposits of primary significance. Reserve estimates for deposits of secondary and tertiary significance are not calculated in Table 3, however the aggregate potential of these deposits is discussed in the report.

## BEDROCK RESOURCES

The method used to calculate resources of bedrock-derived aggregate is much the same as that described above. The areal extent of bedrock formations overlain by less than 25 feet (8 m) of unconsolidated overburden is determined from bedrock geology maps and from the interpretation of available subsurface data. The measured extent of such areas is then multiplied by the estimated quarriable thickness of the rock unit. In most cases a standardized estimate of a quarriable thickness of 60 feet (18 m) is used. Although the thickness of the Precambrian bedrock units in northern Ontario are all probably considerably greater, the 60-foot (18-m) value is considered an appropriate estimate of the maximum thickness of material that can be economically and technologically extracted from a given quarry face. Volume estimates are then multiplied by 3700 (the estimated weight, in Imperial tons, of a one-foot (0.3-m) thick section of Precambrian rock one acre (0.4 ha) in extent, assuming a bulk density of 175 pounds per cubic foot (2720 kg per cubic metre)).

## UNITS AND DEFINITIONS

Although most of the measurements and other primary data available for resource tonnage calculations are given in Imperial untis, Metric units have also been given in the text and on the tables which accompany the report. The Metric equivalent of the data is shown in brackets after or directly below the corresponding Imperial figures. Data are generally rounded off in accordance with the Ontario Metric Practice Guide (Metric Committee 1975).

The tonnage estimates made for sand and gravel as well as bedrock-derived aggregate are termed possible resources in accordance with terminology of the Ontario Resource Classification Scheme (Robertson 1975, p.7) and with the Association of Professional Engineers of Ontario (1976) (see Glossary, Appendix B).

## PART II - DATA PRESENTATION AND INTERPRETATION

Three maps, each portraying a different aspect of the aggregate resources in the study area, accompany the report. Map 1, "Distribution of Sand and Gravel Deposits", gives a comprehensive inventory of the sand and gravel resources in the report area. Map 2, "Selected Sand and Gravel Resources Areas", shows those deposits which are considered to represent the largest and/or highest quality resources in the area. Map 3, "Bedrock Resources", shows the distribution of bedrock lithologies, the distribution of overlying unconsolidated sediments, and identifies the Selected Bedrock Resource Areas.

### MAP 1: DISTRIBUTION OF SAND AND GRAVEL DEPOSITS

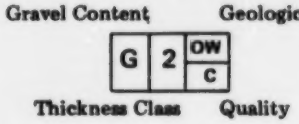
Map 1 is derived directly from existing surficial geology maps of the area or from airphoto interpretation in areas where surficial mapping is incomplete. It shows the extent and quality of sand and gravel deposits within the study area and the present level of extractive activity.

On the map, gravel deposits are indicated by dark brown shading while sand deposits are shaded light brown. The present level of extractive activity is also indicated. Pits are shown by a solid dot and identified by a number which refers to the pit descriptions in Table 2. Each description notes the owner and location of the pit, as well as the estimated face height, percentage gravel and pit status.

Map 1 also presents a summary of available information related to the quality of aggregate contained in all the known aggregate deposits in the study area. Much of this information is contained in the symbols which are found on the map. The Deposit Symbol appears for each mapped deposit and summarizes important genetic and textural data. The Texture Symbol is a circular proportional diagram which displays the grain size distribution of the aggregate in areas where bulk samples were taken.

#### DEPOSIT SYMBOL

The Deposit Symbol is similar to those used in soil mapping and land classification systems commonly in use in North America. The components of the symbol indicate the gravel content, thickness of material, origin (type), and quality limitations for every deposit shown on Map 1. These components are illustrated by the following example:




This symbol identifies an outwash deposit 10 to 20 feet (3 to 6 m) thick containing more than 35 percent gravel. Excess silt and clay may limit uses of the aggregate in the deposit.

The "gravel content" and "thickness class" are basic criteria for distinguishing different deposits. The "gravel content" symbol is an upper case "S" or "G". The "S" indicates that the deposit is generally "sandy" and that gravel-sized aggregate makes up less than 35 percent of the whole deposit. "G" indicates that the aggregate probably contains more than 35 percent gravel.

The "thickness class" indicates a depth range which is related to the potential resource tonnage for each deposit. Four thickness class divisions have been established as shown in the legend for Map 1.

Two smaller sets of letters, divided from each other by a horizontal line, follow the thickness class number. The upper series of letters identify the geologic deposit type (the types are summarized with respect to their main geologic and extractive characteristics in Appendix C) and the lower series of letters identify the main quality limitations that may be present in the deposit as discussed in the next section.

#### TEXTURE SYMBOL

The Texture Symbol provides a more detailed assessment of the grain size distribution in deposits where samples were taken for analysis during field study. The data from which these symbols are derived has been plotted on grain size distribution graphs. The relative amounts of gravel, sand, and silt and clay in the sampled material are shown graphically by the sub-

division of a circle into proportional segments. The following example shows a hypothetical sample consisting of 30 percent gravel, 60 percent sand, and 10 percent silt and clay:

Test hole locations are shown on Map 1 by a solid drill hole symbol. The location of described sections are indicated by a solid triangle symbol.

## MAP 2: SELECTED SAND AND GRAVEL RESOURCE AREAS

Map 2 is an interpretative map derived from an evaluation of the deposits shown on Map 1. The deposits identified on Map 2 are those which are considered to be important in ensuring an adequate resource base for the future.

All the selected sand and gravel resource areas are first delineated by geological boundaries and then classified into three levels of significance: primary, secondary, and tertiary. Each area of primary significance is assessed as to its probable relative value as a resource in the report area and is given a deposit number which denotes its ranking order in that area. All such deposits are shown by dark red shading on Map 2.

**Selected Aggregate Resource Areas of primary significance are not permanent, single, land use units which must be incorporated in an official planning document. They represent areas in which a major resource is known to exist. Such Resource Areas may be reserved wholly or partially for extractive development and/or resource protection within the context of the official plan.**

Deposits of secondary significance are not ranked numerically in this report, but are indicated by light red shading on Map 2. Such deposits are believed to contain significant amounts of sand and gravel. Although deposits of secondary significance are not considered to be the "best" resource areas in the report area, they may contain large quantities of sand and gravel and should be considered as part of the aggregate supply of the area.

Areas of tertiary significance are outlined on the map by a solid line but have no shading. They are neither rated nor considered to be important resource areas because of their low available resources, or because of possible difficulties in extraction. Such areas may be useful for local needs but are unlikely to support large-scale development.

The process by which deposits are evaluated and selected involves the consideration of two sets of criteria. The main selection criteria are site specific, related to the characteristics of individual deposits. Factors such as deposit size, aggregate quality, and deposit location and setting are considered in the selection of those deposits best suited for extractive development. A second set of criteria involves the assessment of local aggregate resources in relation to the quality, quantity, and distribution of resources in the region in which the report area is located. The intent of such a process of evaluation is to ensure the continuing availability of sufficient resources to meet possible future demands.

### SITE SPECIFIC CRITERIA

#### DEPOSIT SIZE

Ideally, selected deposits should contain available sand and gravel resources large enough to support a commercial pit operation using a stationary or portable processing plant. In practice, much smaller deposits may be of significant value depending on the overall reserves in the rest of the municipality. Generally, deposits in Class 1, i.e. those thicker than 20 feet (6 m) and containing more than 35 percent crushable gravel are considered to be most favourable for commercial development. Thinner deposits may be valuable in municipalities with low total resources.

#### AGGREGATE QUALITY

The limitations of natural aggregates for various uses result from variations in the lithology of the particles composing the deposit, and from variations in the size distribution of these particles.

Four indicators of the quality of aggregate may be included in the symbol for each deposit on Map 1. They are: gravel content (G or S), fines (C), oversize (0) and lithology (L).

Three of the indicators deal with grain size distribution. The gravel content, (G or S), indicates the suitability of aggregate for various uses. Deposits containin at least 35 percent

gravel in addition to a minimum of 20 percent material greater than the 26.5 mm sieve are considered to be the most favourable extractive sites, since this content is the minimum from which crushed products can be economically produced.

Excess fines (or high silt and clay content) may severely limit the potential use of an aggregate. Fines content in excess of 10 percent may impede drainage in road sub-base aggregate and render it more susceptible to the effects of frost action. In asphalt aggregate, excess fines hinder the bonding of particles. Deposits known to have a high fines content are indicated by a "C" in the quality portion of the Deposit Symbol.

Deposits containing more than 20 percent oversize material (greater than 4 inches (10 cm) in diameter) may also have use limitations. The oversize component is unacceptable for all concrete aggregate and for road-building aggregate, so it must be either crushed or removed during processing. Deposits known to have an appreciable oversize component are indicated by an "O" in the quality portion of the Deposit Symbol.

The other indicator of the quality of an aggregate is lithology. Just as the unique physical and chemical properties of bedrock types determine their value for use as crushed rock, so do various lithologies of particles in a sand and gravel deposit determine its suitability for various uses. The presence of objectionable lithologies such as chert, siltstone, and shale, even in relatively small amounts, can result in a reduction in the quality of an aggregate, especially for high-quality uses such as concrete and asphalt. Similarly, highly weathered, very porous and friable rock can restrict the quality of an aggregate. Deposits known to contain objectionable lithologies are indicated by an "L" in the quality component of the Deposit Symbol.

If the Deposit Symbol indicates either "C", "O", or "L" or any combination, the quality of the deposit is considered to be reduced for some uses of the aggregate. No attempt has been made to quantify the degree of limitation imposed. Assessment of the four indicators is made from published data, from data contained in files of the Ontario Ministry of Transportation and Communications and the Engineering and Terrain Geology Section of the Ontario Geological Survey, and from field observations.

Analyses of unprocessed samples obtained from test holes or pits have been plotted on grain size distribution graphs. On the graphs are the gradation specification envelopes for Ontario Ministry of Transportation and Communications' products: Granular Base Course A, B and C; and Hot-Laid Asphaltic Sand Nos. 1, 2, 3, 4, 5, 6 and 8. By plotting the gradation curves with respect to the specification envelopes, it can be determined how well the unprocessed sampled material meets the criteria for each product.

### LOCATION AND SETTING

The location and setting of a resource area has a direct influence on its value for possible extraction. The evaluation of a deposit's setting is made on the basis of natural and man-made features which may limit or prohibit extractive development.

First, the physical context of the deposit is considered. Deposits with some physical constraint on extractive development, such as thick overburden or high water table, are less valuable resource areas, because of the difficulties involved in resource recovery. Second, permanent man-made features, such as roads, railways, powerlines, and housing developments, which are built on a deposit, may prohibit its extraction. The constraining effect of legally required setbacks surrounding such features is included in the evaluation. A quantitative assessment of these constraints can be made by measurement of their areal extent directly from the topographic maps. The area rendered unavailable by these features is shown for each resource area in Table 3 (Column 3).

The assessment of sand and gravel deposits and bedrock resource areas with respect to local land use and to private land ownership is an important component of the general evaluation process. These aspects of the evaluation process are not considered further in this report, but readers are encouraged to discuss them with personnel of the pertinent District Office of the Ontario Ministry of Natural Resources.

### REGIONAL CONSIDERATIONS

In selecting sufficient areas for resource development, it is important to assess both the

local and the regional resource base, and to forecast future production and demand patterns.

Some appreciation of future aggregate requirements in an area may be gained by assessing its present production levels and by forecasting future production trends. Such an approach is based on the assumptions that production levels in an area closely reflect the demand and that the present production "market share" of an area will remain roughly at the same level.

The aggregate resources in the region surrounding a municipality should be assessed in order to properly evaluate specific resource areas and to adopt optimum resource management plans. For example, a municipality that has large resources in comparison to its surrounding region constitutes a regionally significant resource area. Municipalities with high resources in proximity to large demand centres, such as metropolitan areas, are special cases.

Although an appreciation of the regional context is required to develop comprehensive resource management techniques, such detailed evaluation is beyond the scope of this report. The selection of resource areas made in this study is based primarily on geological data or on considerations outlined in preceding sections.

## MAP 3: BEDROCK RESOURCES

Map 3 is an interpretative map derived from bedrock geology maps, water well data from the Ontario Ministry of the Environment, drilling assessment data from the Ontario Ministry of Natural Resources and from the Northern Ontario Engineering Geology Terrain Studies produced for the Ontario Geological Survey. Map 3 is based on concepts similar to those outlined for Maps 1 and 2, but displays both the inventory and evaluation on the one map.

The geological boundaries of the bedrock units are shown by a dashed line. Areas where bedrock outcrops, or is within 3 feet (1 m) of the ground surface are indicated by dark blue shading. Isolated bedrock outcrops which lie outside these areas are indicated by a black "X" symbol. These areas constitute potential resource areas of primary significance, because of their easy access. Areas where the bedrock is covered by 3 to 25 feet (1 to 8 m) of drift are indicated by light blue shading. Quarrying is possible in this depth of overburden and these also represent potential resource areas. Outside the delineated areas of thin drift cover, the bedrock is generally overlain by more than 25 feet (8 m) of drift. These areas constitute resources which have extractive value only in specific circumstances and it is unlikely these areas will constitute resource areas of economic significance.

Other inventory information presented on Map 3 is designed to give an indication of the present level of extractive activity in the report area. All known quarries are shown by a dot symbol and identified by a number which refers to the quarry descriptions in Table 5. Each description notes the owner, location and an estimate of face height. One additional symbol appears on the map: an open dot indicates the location of a selected drill hole which penetrates bedrock. The overburden thickness is shown in feet beside the open dot.

### SELECTION CRITERIA

Criteria equivalent to those used for sand and gravel deposits are used to select bedrock areas most favourable for extractive development.

The evaluation of bedrock resources is made primarily on the basis of performance and suitability data established by laboratory testing at the Ontario Ministry of Transportation and Communications. The main characteristics of the bedrock units found in the study area are summarized in Appendix D.

Deposit "size" is related directly to the areal extent of thin drift cover overlying favourable bedrock formations. Quality of the aggregate derived from specific bedrock units is established by the performance standards previously mentioned. Location and setting criteria and regional considerations are identical to those for sand and gravel deposits.

### SELECTED RESOURCE AREAS

Selection of bedrock resource areas has been restricted to a single level of significance. Two factors support this approach. First, the areal extent of a given quarry operation is much smaller than that of a sand and gravel pit producing an equivalent tonnage of material, and second, since crushed bedrock has a higher unit value than sand and gravel, longer haul distances

can be considered. These factors allow the identification of alternative sites having similar development potential. The selected areas are shown on Map 3 by a line pattern and the calculated available tonnages are given in Table 6.

It should be stressed, that the Precambrian Shield rocks in northern Ontario are generally more complex and variable than the Paleozoic rocks of southern Ontario. They often show wide variations in mineralogy, texture (grain size) and degree of weathering, even within specific rock types and over relatively short distances. As these factors are considered important in determining the suitability of the bedrock for use as aggregate, the aggregate potential may also vary considerably from location to location.

Careful selection is especially important if the bedrock is to be used as concrete aggregate. Deleterious chemical reactions may develop in the concrete which can lead to its eventual deterioration. Fortunately, these chemical reactions should not influence the use of bedrock-derived aggregate for hot-laid asphaltic and road-base material. However, highly weathered, very porous and friable rock should be avoided for all uses.

For these reasons, the total area selected as a bedrock resource should not be considered acceptable for aggregate use. They are, however, areas in which the probability of finding a supply of acceptable aggregate is considered most likely.

**Selected Bedrock Resource Areas shown on Map 3 are not permanent, single land use units which must be incorporated in an official planning document. They represent areas in which a major bedrock resource is known to exist. Such a Resource Area may be reserved wholly or partially for extractive development and/or resource protection within the context of the official plan.**

## PART III - ASSESSMENT OF AGGREGATE RESOURCES IN THE EASTERN PART OF THE CITY OF TIMMINS

### LOCATION AND POPULATION

The study area occupies approximately 92,000 acres (37 000 ha) in the eastern part of the City of Timmins. It consists of Evelyn, Matheson, German and Macklem townships, and also includes two small areas in Dundonald Township situated west of Fredrick House Lake and River. The area is covered by the Pamour (42 A/11), Porquis Junction (42 A/10) and Watabeag River (42 A/7) map sheets of the National Topographic System, at a scale of 1:50 000.

The population of the area was 548 in 1980. Figures from previous years indicate that the population has increased by approximately 7 percent since 1973 (Ron Peterson, Director of Planning, City of Timmins, personal communicaion, 1981). German and Matheson townships account for 98 percent of the area's population. Kettle Lakes Provincial Park is situated in south-central German Township and is the major recreational centre in the area. Cottages are found along the shores of several lakes in the area.

Access to sand and gravel resources within the project area is provided by the King's Highways 101 and 67, and Secondary Highway 610. Paved, gravel-surfaced and bush or logging roads also supply access. A line of the Ontario Northland Railway trends northeast through the area.

### PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The physiography and distribution of unconsolidated sediments including sand and gravel deposits, are largely the result of glacial activity during the Wisconsinan Stage of the Pleistocene Epoch. This period of time, which lasted from approximately 100 000 to 7000 years ago, was marked by the repeated advance and melting back of massive, continental ice sheets.

The oldest surficial sediment in the Timmins area has been referred to informally as the "lower till" by Hughes (1965) and may be the correlative of the Adam Till exposed in the Moose River basin (Skinner 1973). This lower till, deposited as the ice advanced to the south, is exposed at the surface in parts of Evelyn and Matheson townships. In many areas, this till has been reworked by glaciolacustrine action. It is a stony, silty sand to sand till which, in places, may be suitable for use as fill.

As the ice front retreated northward, waters of proglacial Lake Barlow-Ojibway covered the area. Sand and gravel was deposited in the form of esker complexes as meltwater flowed under the ice and exited into the lake at the ice margin. These complex features trend north-south across the study area and usually consist of a series of segmented esker ridges flanked by deltaic sediments. The esker ridges may have been deposited at or near the terminus of subglacial streams that flowed into the lake (Richard 1981; Tucker, in prep.). The sediments exposed in the ridges range from fine sand containing silt layers to coarse gravel. The esker ridges contain most of the report area's possible resources of crushable gravel.

The deltaic sediments are generally finer textured than the eskerine material and consist of sand with occasional gravel pockets. The deltaic material is often well stratified and usually becomes finer the further it is from the esker ridges. The deltas were probably deposited as the strength of flow descreased away from the exit of subglacial streams into Lake Barlow-Ojibway. In certain areas, the deltaic sediments have been extensively reworked by glaciolacustrine processes and these areas have been given a dual designation of glaciolacustrine delta-glaciolacustrine plain on Map 1. Large possible resources of generally low-specification construction aggregate are available from the deltaic deposits.

The subglacial streams which provided the source material for the esker complexes also carried silt and clay which was deposited in the deep waters of Lake Barlow-Ojibway as either varved or massive silt and clay. The glaciolacustrine silt and clay is the predominant glacial sediment in the project area and in places may overlie esker complex sediments and lower till. It has no value as aggregate.

The previously deposited esker complexes and lower till provided the source material for

shallow water sand deposits within the study area (Tucker, in prep.). The glaciolacustrine sands have low value as aggregate because of their fine texture. In some areas, they blanket the esker complexes, lower till and deep water glaciolacustrine deposits. As the lake level lowered, nearshore features such as beaches and bars were deposited (Tucker, in prep). Sedimentation occured mainly along the esker complexes and exposures of lower till. Some of the beach deposits may be suitable for small-scale extraction.

During a late stage of the existence of this lake, the ice readvanced and deposited the Cochrane till (Hughes 1959; 1965). The ice readvanced as far south as northern Evelyn Township and overrode previously deposited sediments. It deposited a silty clay to clay till which has no value as aggregate.

After the waters of Lake Barlow-Ojibway drained, the glaciolacustrine sands became susceptible to postglacial wind erosion and transport. Deposition of eolian sand occured mainly in the form of parabolic dunes (Tucker, in prep.). Dune sand is especially abundant in central Evelyn Township.

The deposition of alluvium and the development of numerous swamps has also modified the physiography of the study area. Alluvium occurs chiefly along the course of existing creeks and rivers. Swamps occur extensively in low-lying areas underlain by glaciolacustrine deep water sediments or Cochrane till.

## EXTRACTIVE ACTIVITY

Numerous sand and gravel pits have been opened in the project area. At the time of writing, 3 pits were active on a demand basis and 6 showed signs of recent extraction. The majority of the pits are located in two esker complexes which trend north-south through the study area. One of the complexes is situated in Evelyn Township. A number of small, borrow pits have been developed in this esker complex. The aggregate from these pits has been used mainly for local use within the township. The other esker complex traverses German and Macklem townships. Most of the extractive development in the complex has taken place within esker ridges or along the King's Highway 101. The esker ridges contain most of the report area's possible resources of crushable gravel. Two isolated delta deposits in Evelyn and Matheson townships have also produced sand and gravel within the project area.

## SELECTED SAND AND GRAVEL RESOURCE AREAS

The sand and gravel deposits selected for possible resource protection in the study area are shown on Map 2. Two esker segments in Evelyn Township, one in German Township and three in Macklem Township have been selected as Sand and Gravel Resource Areas of Primary Significance. In addition, several deposits have been selected as Sand and Gravel Resource Areas of Secondary Significance.

Petrographic examination of the coarse aggregate from several samples taken in the Timmins area revealed that the aggregate is generally suitable for granular base course and 5/8 inch (16 mm) crushed stone, but its use as hot-laid asphaltic stone and concrete stone is restricted when extracted from some pits. The presence of soft and friable clasts is variable and is the major limiting factor in respect to petrographic quality. The petrographic examinations also revealed minor quanities of chert in the samples and Hunt (1981) found the chert content to range from 0 to 4 percent.

In many instances, the depth of sand and gravel in the resource areas exceeds 100 feet (30 m) as indicated by overburden drill hole data. These depths often do not reflect the actual depth of extraction because of economic and engineering considerations. Also, the quality of the aggregate may vary at depth. As a result, the average deposit thickness is based largely on the face heights present in pits located within the selected deposits, together with test hole and other subsurface data as available. Where pits were not present, these subsidary data sources provided the bulk of the information on which the calculations are based.

The Selected Resource Areas of Primary Significance occupy a total available area of 470 acres (190 ha). They contain possible sand and gravel resources of approximately 53 million tons (48 million tonnes). The available parts of the selected areas represent 2 percent of the total area of sand and gravel deposits in the project area, and 4 percent of the total resource

tonnage (Tables 1 and 3). The resource areas contain most of the possible resources of crushable gravel in the study area and are usually bush covered.

### SELECTED SAND AND GRAVEL RESOURCE AREA 1

Selected Sand and Gravel Resource Area 1 consists of two esker segments that trend southward along Gibson Lake Road in Macklem Township. The esker segments rise up to 30 feet (9 m) above the surrounding terrain and have been subdivided into two separate areas based on sand and gravel content.

Area 1a comprises the southern portion of the esker. Coarse gravel and large erratics are exposed on its surface and subsurface information indicates the gravel is present at depth. Three pits have been opened in the Area, one of which is active on a demand basis (pit no. 30). Faces in pit no. 30 range in height from 15 to 40 feet (5 to 12 m) and expose 6 to 20 feet (2 to 6 m) of medium to coarse gravel over sandy gravel. A sample was taken from the upper gravel layer and found to contain 71 percent gravel and 29 percent sand (Figures 3a and 3b, Pit 30a). The lower, sandy gravel unit was also sampled and contained 35 percent gravel and 65 percent sand (Figures 3a and 3b, Pit 30b). Fine sand pockets are occasionally present in the lower unit. The Ministry of Transportation and Communications (M.T.C.) report that the aggregate from this pit is suitable for 5/8 inch (16 mm) Crushed B, and Granular Base Course A and C. Sand control, however, may be required in places for Granular Base Course A and crushed stone. In addition, oversize material is present which should be processed or removed.

Gravel similar to that revealed in pit no. 30 is exposed in pit no. 29 and test hole TM-TH-11. A sample taken from the test hole contained 68 percent gravel and 32 percent sand (Figures 4a and 4b). South of this test hole the gravel content decreases and the gravel becomes finer. At test hole TM-TH-12, 10 feet (3 m) of fine to medium gravelly sand was uncovered containing 27 percent gravel and 73 percent sand (Figures 4a and 4b). At pit no. 32, 10 to 15 feet (3 to 5 m) of sandy gravel is exposed. The gravel is found predominantly in pockets within the sandy sediment. One of these pockets was sampled revealing 66 percent gravel and 34 percent sand (Figures 4a and 4b).

Area 1b forms the northern part of the Resource Area and includes a small segment of the esker situated north of Legare Lake. Material exposed on the surface of the esker is predominantly sand, although gravel is sporadically seen at the surface. One pit has been opened in the Area (pit no. 28) and faces expose up to 15 feet (5 m) of irregularly stratified sand and gravel, in which the gravel is concentrated in lenses within the sandy sediment. A sample was taken from a gravel lense in this pit and contained 67 percent gravel and 33 percent sand (Figures 3a and 3b). However, the overall gravel content is marginal. Further subsurface investigation is required to determine the quality of the aggregate, especially in the undeveloped areas north of the pit.

Resource Area 1 occupies 315 acres (127 ha). Cultural constraints and previous extraction reduce the area currently available to 235 acres (95 ha). Assuming an average thickness of 35 feet (11 m) for Area 1a and 50 feet (15 m) for Area 1b, available sand and gravel resources are estimated to total 23 million tons (21 million tonnes). Resource Area 1 is accessible via Gibson Lake Road which branches off King's Highway 101.

### SELECTED SAND AND GRAVEL RESOURCE AREA 2

Sand and Gravel Resource Area 2 is an esker deposit situated east of King's Highway 67 in north-central German Township. The esker segment is approximately 2 miles (3.2 km) long and two pits (pit nos. 20 and 21) and part of a third (pit no. 19) have been developed in this deposit.

Faces in pit no. 20 expose up to 50 feet (15 m) of irregularly stratified sand and gravel. The gravel is found predominantly in pockets within the sandy sediment. Fine sand lenses which frequently contain clay and silt seams are also present. The gravel pockets have been selectively extracted to produce 5/8 inch (16 mm) Crushed B. Granular Base Course A and C, and Hot-Laid No. 4 sand and stone have also been produced from this pit. The high variability of the material in this pit is the major factor controlling the quality of the aggregate.

Similar material is exposed in pit no. 21, located south of the aforementioned pit. A gravel pocket was sampled in this pit and found

to contain 74 percent gravel and 26 percent sand (Figures 3a and 3b). Sand is exposed in pit no. 19 which extends into the esker deposit.

Resource Area 2 occupies 130 acres (53 ha), of which 55 acres (22 ha) are presently available for extraction. Assuming an average deposit thickness of 50 feet (15 m), resources of sand and gravel are estimated to be 7 million tons (6 million tonnes). The position of the esker adjacent to a number of lakes may restrict extractive development in parts of the Area. The Resource Area is accessible via two gravel-surfaced roads which branch off the King's Highway 67.

#### SELECTED SAND AND GRAVEL RESOURCE AREA 3

Sand and Gravel Resource Area 3 consists of two esker segments situated in northwestern Evelyn Township. Each segment is flanked by deltaic sand and gravel and kettle depressions. Two small borrow pits have been developed in the Resource Area. Faces in pit no. 1, located in the northern esker segment, expose up to 10 feet (3 m) of gravelly sand. Gravelly sand is also exposed in the southern esker segment at pit no. 5. In both pits the coarse fraction of the gravel averages 2 to 3 inches (5 to 7.5 cm) in size and is concentrated in the pit's upper levels.

Two test holes were placed in the Resource Area. Test hole TM-TH-5 was placed adjacent to pit no. 1 revealing 10 feet (3 m) of gravelly sand over 40 feet (12 m) of medium sand. Up to 3 feet of gravelly sand overlies 6 feet (2 m) of medium sand at test hole TM-TH-4. The gravelly sand layer was sampled and found to contain 28 percent fine gravel and 72 percent sand (Figures 2a and 2b).

Selected Resource Area 3 comprises 165 acres (67 ha), of which 150 acres (61 ha) are currently available for extraction. Assuming an average thickness of 50 feet (15 m), available resources of sandy aggregate are estimated to be 19 million tons (17 million tonnes). The presence of cottages along Ice Chest Lake may inhibit extractive development in parts of the southern esker segment. The Resource Area is accessible by a number of gravel- and sand-surfaced roads.

#### SELECTED SAND AND GRAVEL RESOURCE AREA 4

Sand and Gravel Resource Area 4 is a small esker segment situated in southeastern Macklem Township. Little subsurface information is available for this deposit, although, at one location 20 feet (6 m) of gravelly sand is exposed in a cut into the side of the esker ridge. Even though this deposit is of small size in Macklem Township it extends southeastward into Bond Township (outside the project area). Therefore, considerable amounts of sand and gravel may be available from this esker. However, further investigation is required to establish the overall quality of the aggregate.

Selected Resource Area 4 occupies 30 acres (12 ha) currently available for extraction. Assuming an average thickness of 50 feet (15 m) available resources of sand and gravel are estimated to be 4 million tons (4 million tonnes).

#### SAND AND GRAVEL RESOURCE AREAS OF SECONDARY SIGNIFICANCE

Several deposits located within the study area have been selected as Sand and Gravel Resource Areas of Secondary Significance. These deposits are predominantly sand sources, although small quantities of coarse aggregate may be present locally. Large possible resources of generally low-specification construction aggregate are available from these deposits and the secondary areas should be considered as part of the area's aggregate supply.

The deltaic deposit situated south of Kettle Lakes Provincial Park in German Township, and east of Resource Area 1 in Macklem Township has been selected as a Sand and Gravel Resource Area of Secondary Significance. Faces in pit nos. 23 to 26 range from 30 to 45 feet (9 to 14 m) exposing well stratified, fine to medium sand with occasional gravel pockets. Silt and clay seams are common within fine sand layers and it appears that the gravel pockets have been selectively extracted. In pit no. 22 at the eastern margin of the deposit, gravel lenses are concentrated in the upper 8 feet (2 m) of the exposed faces. Further to the south in the area, test hole TM-TH-9 revealed 50 feet (15 m) of fine to coarse sand and test hole TM-TH-10 uncovered 6 feet (2 m) of similar material. In the area surrounding pit no. 31, gravel beds become relatively more abundant, especially near the surface. A 15- foot (5-m) face in pit no. 31 exposed 5 feet (2 m) of medium gravel over slumped material.

Flanking Resource Area 3 in Evelyn Township is a deltaic deposit. The deposit exhibits hummocky relief and material exposed at the

surface is largely sand, although gravel beds are occasionally present. Faces in pit nos. 3, 4, 6 and 7 range in height from 4 to 7 feet (1 to 2 m) and expose sand with minor amounts of gravel. Test holes TM-TH-1, TM-TH-2 and TM-TH-7 uncovered up to 8 feet (2 m) of similar material. Fifty feet (15 m) of medium sand was revealed at test hole TM-TH-3. Coarse aggregate was found at two locations in the area. In pit no. 2, 10 feet (3 m) of sandy gravel is exposed. A sample from a gravel pocket in this pit contained 57 percent gravel and 43 percent sand (Figures 2a and 2b). Test hole TM-TH-6 was also sampled and found to contain 42 percent gravel (Figures 2a and 2b).

Two glaciolacustrine delta-glaciolacustrine plain deposits which adjoin the aforementioned area have also been selected at the secondary level of significance. Material exposed at the surface is dominantly sand. Two pits have been opened in the southernmost deposit. The faces in the pits range from 5 to 10 feet (2 to 3 m) and expose chiefly clean medium sand.

A glaciolacustrine delta deposit is situated west of Resource Area 1 in Macklem Township. No pits have been developed in this area and surface exposure is predominantly sand. However, some gravel is exposed on a subdued ridge situated between Jane and Round Lakes. This ridge may represent a segment of the same esker that forms Resource Area 1 which has been reworked by glaciolacustrine action.

A delta deposit which flanks Resource Area 2 in German Township contains sand that has been used for Granular Base Course C and Hot-Laid No. 4 sand. One pit (pit no. 18) and part of a second pit (pit no. 19) have been opened in the deposit with faces exposing up to 25 feet (8 m) of sand. Test hole TM-TH-8 was placed northeast of Charland Lake along King's Highway 67 revealing 35 feet (11 m) of medium sand.

Two isolated delta deposits are situated in Matheson and Evelyn townships. Two pits have been developed in the deposit located in southeastern Evelyn Township. Faces in the pits generally expose gravelly sand although a sample from pit no. 11 contained 47 percent gravel and 53 percent sand (Figures 2a and 2b). The deposit in central Matheson Township has been extensively used and only small quantities of sandy aggregate remain. The eastern and northeastern part of this deposit is buried by up to 10 feet (3 m) of varved silt and clay (Hunt 1981), and the northern edge by lower till. Coarse aggregate has been extracted from the eastern part of pit no. 12, but the pit is currently water filled. Water is also present on the floors of several other pits in these deposits.

The final area selected at the secondary level consists of four deposits situated in southeastern Macklem Township. They include the glaciolacustrine delta-glaciolacustrine plain deposit surrounding Long Lake, the delta deposit which flanks Resource Area 4 and two glaciolacustrine beach deposits. Material exposed at the surface is predominantly sand, however, coarse gravel and large erratics are exposed east of Gibson Lake Road and south of Long Lake in the glaciolacustrine delta-glaciolacustrine plain deposit. This coarse aggregate appears to have been left on the surface of the deposit as a lag layer as a result of glaciolacustrine reworking of the sediments. The two beach ridges also contain quantities of coarse aggregate. Test hole TM-TH-14 was placed in one of these ridges. A sample taken from this test hole contained 40 percent gravel and 60 percent sand (Figure 4a and 4b). Considerable quantities of sand and minor amounts of gravel are available from this area.

## BEDROCK GEOLOGY

For the most part, the bedrock in the project area is Early Precambrian (Archean) in age. The exception is some diabase dikes of Late Precambrian age which traverse the area. The bedrock is part of the Superior Province of the Canadian Shield and consists largely of metavolcanic and metasedimentary rocks. The general bedrock geology of the area has been described by Leahy (1971) and Pyke (1980b) and parts of their reports are paraphrased herein. Overburden in the area is usually more than 50 feet (15 m) thick and in places exceeds 300 feet (91 m).

The metavolcanic rocks have been subdivided on Map 3 into intermediate and mafic (Rock Type A), and felsic (Rock Type B) varieties. The intermediate and mafic metavolcanics consist of massive and pillowed lavas, and intermediate to mafic volcanic fragmental rocks. The felsic metavolcanics include rhyolites and rhyodacites along with a variety of felsic pyroclastic rocks. These rocks have not been selected for resource

protection as they are frequently sheared and some varieties weather easily.

Metasedimentary rocks (Rock Type C) of two ages underlie the area. The older metasediments consist dominantly of inter-layered greywacke, siltstone and lesser amounts of conglomerate, and form what is mainly a turbidite sequence. A belt of younger sedimentary rock trends east-west across the southern part of German and Matheson townships, and the northwestern part of Macklem Township. The belt consists dominantly of coarse greywackes and conglomerates. The metasedimentary rocks underlie a large proportion of German and Macklem townships, however, only a small part of the area is covered by less than 25 feet (8 m) of drift.

Sill-like bodies of metamorphosed ultramafic rocks (Rock Type D) were emplaced within the aforementioned rock types. The largest of these bodies is situated in northwestern Evelyn Township. Dunites make up a considerable proportion of this rock type and they weather too easily for use as aggregate. Three small bodies of metamorphosed mafic rock (Rock Type E) were intruded into the metavolcanic rocks in Evelyn and Matheson townships. The bodies consist largely of gabbro and diorite. These rocks are generally suitable for extractive development but have not been selected as only a small part of one of the bodies, located in Evelyn Township, lies below less than 25 feet (8 m) of drift and access to this area is a problem.

A small body of felsic intrusive rock (Rock Type F) intruded the metasedimentary rock in Matheson Township. It has not been selected for resource protection as the drift thickness exceeds 25 feet (8 m).

Diabase dikes (Rock Type G) cut the aforementioned rock types in the study area. Both quartz- and olivine-bearing varieties occur. These dikes are generally covered by overburden in excess of 25 feet thick and are usually too thin for economical extraction.

## SUMMARY

The Eastern Part of the City of Timmins has resources of sand and gravel which should be sufficient to meet local needs for a considerable period of time. However, possible resources of good-quality crushable gravel are limited. Although several deposits have been selected at the primary and secondary levels, careful management is necessary to preserve as much of the resources as possible.

The project area is underlain predominantly by metavolcanic and metasedimentary rocks of Precambrian age. No bedrock has been selected for resource protection as only a small amount of the bedrock lies below less than 25 feet (8 m) of drift.

Enquiries regarding the Aggregate Resources Inventory of the Eastern Part of the City of Timmins should be directed to the Ontario Ministry of Natural Resources either at the Timmins District Office, 896 Riverside Drive, Timmins, Ontario, P4N 3W2 (Tel. (705) 267-7951) or at the Northern Region Sub-Office, 60 Wilson Avenue, Timmins, Ontario, P4N 2S7 (Tel. (705) 267-1401).

**TABLE 1 | TOTAL SAND AND GRAVEL RESOURCES, EASTERN PART OF THE CITY OF TIMMINS***

| 1<br>CLASS NO. | 2<br>DEPOSIT TYPE<br>(see Appendix C) | 3<br>AREAL EXTENT<br>Acres<br>(Hectares) | 4<br>ORIGINAL TONNAGE<br>Millions of<br>Tons (Tonnes) |
|---|---|---|---|
| 1 | G-E | 230<br>(93) | 20<br>(18) |
| | S-E | 410<br>(166) | 51<br>(46) |
| | S-LD | 8200<br>(3300) | 1020<br>(920) |
| | S-LD•LP | 3050<br>(1230) | 250<br>(227) |
| 2 | S-LB | 195<br>(79) | 6<br>(5) |
| | S-LD | 295<br>(119) | 12<br>(11) |
| | S-LD•LP | 205<br>(83) | 6<br>(5) |
| | S-LP | 850<br>(345) | 23<br>(21) |
| 3 | G-LB | 12<br>(5) | <1<br>(<1) |
| | S-LB | 25<br>(10) | <1<br>(<1) |
| | S-LP | 1710<br>(690) | 37<br>(34) |
| | S-WD | 300<br>(121) | 6<br>(5) |
| 4 | S-LP | 5900<br>(2390) | 59<br>(54) |
| | | 21,400<br>(8700) | 1490<br>(1350) |

* Identified deposit areas within Kettle Lakes Provincial Park are omitted on all tables.

N.B. Minor variations in all tables are caused by rounding of data.

**TABLE 2 | SAND AND GRAVEL PITS, EASTERN PART OF THE CITY OF TIMMINS**

| 1<br>NO. | 2<br>MTC NO. | 3<br>OWNER/OPERATOR | 4<br>LOT | 5<br>CON. | 6<br>FACE HEIGHT<br>Feet<br>(Metres) | 7<br>% GRAVEL | 8<br>PIT STATUS |
|---|---|---|---|---|---|---|---|
| 1 | | Crown Land | N½ 7 & 8 | 5 | 5-10<br>(2-3) | 20 | inactive |
| 2 | | M.T.C. | S½ 7 & 8 | 5 | 10<br>(3) | 20-40 | recently used |
| 3 | | Crown Land | S½ 10 | 5 | 6<br>(2) | 1-5 | partially overgrown |
| 4 | | | S½ 8 | 5 | 5<br>(2) | 1-5 | partially overgrown |
| 5 | | Crown Land | N½ 8 | 4 | 5-10<br>(2-3) | 5 | inactive |
| 6 | | Crown Land | N½ 6 | 4 | 5<br>(2) | 3 | partially overgrown |
| 7 | | Crown Land | 7 & 6 | 3 | 4-7<br>(1-2) | 5-8 | inactive |
| 8 | | Crown Land | 6 | 3 | 5<br>(2) | 1-5 | partially overgrown |
| 9 | | Crown Land | 6 | 3 | 10<br>(3) | 1-5 | partially overgrown |
| 10 | | Crown Land | 3 | 1 | 4<br>(1) | 5-10 | partially overgrown |
| 11 | Pj-122-24 | Crown Land | 3 | 1 | 5-9<br>(2-3) | 20-30 | inactive |
| 12 | Pa-112-8 | Miller Paving Ltd. | N½ 7 & 8 | 4 | 5-15<br>(2-5) | 2-10 | inactive, depleted |
| 13 | Pa-112-2 | R. Bouvier | N½ 6 | 4 | 5-10<br>(2-3) | sand | partially overgrown |
| 14 | Pa-112-1 | H. Pajala | S½ 7 | 4 | 10-12<br>(3-4) | 10 | partially overgrown |
| 15 | | H. Pajala | S½ 7 | 4 | 5-15<br>(2-5) | 1-3 | partially overgrown |
| 16 | Pa-112-5 | F. Savage | N½ 8 | 2 | 5<br>(2) | sand | partially overgrown |

**TABLE 2 | SAND AND GRAVEL PITS, EASTERN PART OF THE CITY OF TIMMINS**

| 1<br>NO. | 2<br>MTC NO. | 3<br>OWNER/OPERATOR | 4<br>LOT | 5<br>CON. | 6<br>FACE HEIGHT<br>Feet<br>(Metres) | 7<br>% GRAVEL | 8<br>PIT STATUS |
|---|---|---|---|---|---|---|---|
| 17 | | | 8 & 9 | 6 | 20-30<br>(6-9) | 5 | inactive |
| 18 | Pj-122-40 | Crown Land | S½ 7 | 4 | 10-20<br>(3-6) | 1-5 | inactive |
| 19 | Pj-122-39 | Crown Land | S½ 8 | 4 | 15-25<br>(5-8) | 5-10 | inactive |
| 20 | Pj-122-41 | M.J. Labelle Co. Ltd. | N½ 7 & 8 | 5 | 30-50<br>(9-15) | 20-30 | active<br>on demand |
| 21 | | M.J. Labelle Co. Ltd.<br>(M.N.R. Quarry Permit) | 7 & 8 | 5 | 25-35<br>(8-11) | 15-20 | active<br>on demand |
| 22 | Pj-122-42 | M.T.C. | N½ 3 | 1 | 10-15<br>(3-5) | 10-20 | recently<br>used |
| 23 | | Crown Land | N½ 5 | 1 | 40<br>(12) | 2-5 | inactive |
| 24 | Pj-122-4 | M.T.C. | 5 | 1 | 40-45<br>(12-14) | 5 | inactive |
| 25 | | W. Deluca | S½ 5 | 1 | 30-40<br>(9-12) | 1-2 | inactive |
| 26 | Pj-122-5 | partly by J. Moffat<br>and M.T.C. | S½ 5 | 1 | 30<br>(9) | 2-5 | inactive |
| 27 | | K. Stringer | S½ 4 | 1 | 15-20<br>(5-6) | sand | partially<br>overgrown |
| 28 | | P. Thereault<br>(M.N.R. Quarry Permit) | 4 | E | 10-15<br>(3-5) | 25-35 | recently<br>used |
| 29 | Pj-122-13 | Equiplant<br>(M.N.R. Quarry Permit) | 3 & 4 | E | 15-30<br>(5-9) | 35-50 | recently<br>used |
| 30 | Pj-122-13 | Miller Paving Co. Ltd. | 3 | E | 15-40<br>(5-12) | 35-60 | active<br>on demand |
| 31 | | H. Wieland | 3 | E | 10-20<br>(3-6) | 40 | recently<br>used |
| 32 | | City of Timmins<br>(M.N.R. Quarry Permit) | 3 | D | 10-15<br>(3-5) | 20-35 | recently<br>used |

TABLE 3 | SELECTED SAND AND GRAVEL RESOURCE AREAS, EASTERN PART OF THE CITY OF TIMMINS

| 1<br>DEPOSIT NO. | 2<br>AREA<br>Acres<br>(Hectares) | 3<br>CULTURAL SETBACKS<br>Acres<br>(Hectares) | 4<br>EXTRACTED AREA<br>Acres<br>(Hectares) | 5<br>AVAILABLE AREA<br>Acres<br>(Hectares) | 6<br>ESTIMATED DEPOSIT THICKNESS<br>Feet (Metres) | 7<br>AVAILABLE AGGREGATE<br>Millions of<br>Tons (Tonnes) |
|---|---|---|---|---|---|---|
| 1a | 230<br>(93) | 50<br>(20) | 20<br>(8) | 160<br>(65) | 35<br>(11) | 14<br>(13) |
| 1b | 85<br>(34) | 5<br>(2) | 5<br>(2) | 75<br>(30) | 50<br>(15) | 9<br>(8) |
| 2 | 130<br>(53) | 50<br>(20) | 25<br>(10) | 55<br>(22) | 50<br>(15) | 7<br>(6) |
| 3 | 165<br>(67) | 10<br>(4) | 5<br>(2) | 150<br>(61) | 50<br>(15) | 19<br>(17) |
| 4 | 30<br>(12) | 0<br>(0) | 0<br>(0) | 30<br>(12) | 50<br>(15) | 4<br>(4) |
| | 640<br>(260) | 115<br>(46) | 55<br>(22) | 470<br>(190) | | 53<br>(48) |

TABLE 4 | TOTAL IDENTIFIED BEDROCK RESOURCES, EASTERN PART OF THE CITY OF TIMMINS*

| 1<br>DRIFT THICKNESS<br>Feet (Metres) | 2<br>BEDROCK<br>LITHOLOGY | 3<br>QUARRIABLE<br>THICKNESS<br>Feet (Metres) | 4<br>AREAL EXTENT<br>Acres<br>(Hectares) | 5<br>ORIGINAL TONNAGE<br>Millions of<br>Tons (Tonnes) |
|---|---|---|---|---|
| 0-3<br>(0-1) | Type A | 60<br>(18) | 65<br>(26) | 14<br>(13) |
| 3-25<br>(1-8) | Type A | 60<br>(18) | 690<br>(280) | 153<br>(139) |
| | | | 760<br>(310) | 167<br>(152) |
| 0-3<br>(0-1) | Type C | 60<br>(18) | 24<br>(10) | 5<br>(4) |
| 3-25<br>(1-8) | Type C | 60<br>(18) | 116<br>(147) | 26<br>(24) |
| | | | 140<br>(57) | 31<br>(28) |
| 3-25<br>(1-8) | Type D | 60<br>(18) | 8<br>(3) | 2<br>(2) |
| 3-25<br>(1-8) | Type E | 60<br>(18) | 60<br>(24) | 13<br>(12) |
| | | | 970<br>(390) | 213<br>(193) |

* Bedrock resources of Type G rock (diabase dikes) are omitted on this table because of the dikes' small areal extent.

TABLE 5 | QUARRIES, EASTERN PART OF THE CITY OF TIMMINS

| 1<br>NO. | 2<br>MTC NO. | 3<br>OWNER/OPERATOR | 4<br>LOT | 5<br>CON. | 6<br>FACE HEIGHT<br>Feet (Metres) | 7<br>QUARRY<br>STATUS |
|---|---|---|---|---|---|---|

– NONE –

TABLE 6 | SELECTED BEDROCK RESOURCE AREAS, EASTERN PART OF THE CITY OF TIMMINS

| 1<br>DEPOSIT NO. | 2<br>DEPTH OF OVERBURDEN<br>Feet<br>(Metres) | 3<br>AREA<br>Acres<br>(Hectares) | 4<br>CULTURAL SETBACKS<br>Acres<br>(Hectares) | 5<br>EXTRACTED AREA<br>Acres<br>(Hectares) | 6<br>AVAILABLE AREA<br>Acres<br>(Hectares) | 7<br>ESTIMATED QUARRIABLE THICKNESS<br>Feet (Metres) | 8<br>AVAILABLE RESOURCES<br>Millions of Tons (Tonnes) |
|---|---|---|---|---|---|---|---|
| – NONE – | | | | | | | |

## TABLE 7 | SUMMARY OF TEST HOLE DATA, EASTERN PART OF THE CITY OF TIMMINS

Test Hole Number: TM-TH-1

Location: Evelyn Township, Conc. 6, Lot 10

Elevation: Approx. 1070 feet (325 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-4 (0-1) | clean medium sand with trace amounts of fine gravel |

Test Hole Number: TM-TH-2

Location: Evelyn Township, Conc. 6, Lot 10

Elevation: Approx. 1100 feet (335 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-4 (0-1) | clean medium sand with minor amounts of fine gravel |
| 4-8 (1-2) | fine to medium sand |

## TABLE 7 | SUMMARY OF TEST HOLE DATA, EASTERN PART OF THE CITY OF TIMMINS

Test Hole Number: TM-TH-3

Location: Evelyn Township, Conc. 6, Lot 7

Elevation: Approx. 1100 feet (335 m) a.s.l.

Date: August 2 & 3, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-10 (0-3) | clean medium sand |
| 10-30 (3-9) | clean medium sand with some coarse sand |
| 30-50 (9-15) | clean medium sand |

Test Hole Number: TM-TH-4

Location: Evelyn Township, Conc. 6, Lot 8

Elevation: Approx. 1100 feet (335 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-3 (0-1) | clean gravelly sand |
| 3-9 (1-3) | clean medium sand |

**TABLE 7 | SUMMARY OF TEST HOLE DATA, EASTERN PART OF THE CITY OF TIMMINS**

Test Hole Number: TM-TH-5

Location: Evelyn Township, Conc. 5, Lot 7 & 8

Elevation: Approx. 1150 feet (350 m) a.s.l.

Date: August 2, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-10 (0-3) | clean coarse sand with some fine to coarse gravel |
| 10-40 (3-12) | clean medium sand |
| 40-50 (12-15) | clean medium sand with some fine sand |

Test Hole Number: TM-TH-6

Location: Evelyn Township, Conc. 5, Lot 8

Elevation: Approx. 1130 feet (345 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-3 (0-1) | clean medium gravel with a coarse sand and fine gravel matrix |
| 3-6 (1-2) | clean coarse sand with occasional fine to medium gravel layers |
| 6-9 (2-3) | clean coarse sand |

## TABLE 7 | SUMMARY OF TEST HOLE DATA, EASTERN PART OF THE CITY OF TIMMINS

Test Hole Number: TM-TH-7

Location: Evelyn Township, Conc. 6, Lot 8

Elevation: Approx. 1100 feet (335 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-5 (0-2) | clean medium sand |

Test Hole Number: TM-TH-8

Location: German Township, Conc. 4, S½ Lot 8

Elevation: Approx. 920 feet (280 m) a.s.l.

Date: August 3, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-35 (0-11) | medium sand |

## TABLE 7 | SUMMARY OF TEST HOLE DATA, EASTERN PART OF THE CITY OF TIMMINS

Test Hole Number: TM-TH-9

Location: Macklem Township, Conc. F, Lot 3

Elevation: Approx. 900 feet (275 m) a.s.l.

Date: August 3, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-5 (0-2) | clean medium sand |
| 5-10 (2-3) | clean medium to coarse sand |
| 10-20 (3-6) | clean coarse sand |
| 20-30 (6-9) | clean coarse sand with some medium sand |
| 30-40 (9-12) | fine to medium sand |
| 40-50 (12-15) | silty fine sand |

Test Hole Number: TM-TH-10

Location: Macklem Township, Conc. E, Lot 3

Elevation: Approx. 950 feet (290 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-6 (0-2) | medium sand |

## TABLE 7 | SUMMARY OF TEST HOLE DATA, EASTERN PART OF THE CITY OF TIMMINS

Test Hole Number: TM-TH-11

Location: Macklem Township, Conc. D, Lot 3

Elevation: Approx. 950 feet (290 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-8 (0-2) | medium to coarse gravel |

Test Hole Number: TM-TH-12

Location: Macklem Township, Conc. D, Lot 3

Elevation: Approx. 950 feet (290 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-3 (0-1) | clean sandy gravel |
| 3-10 (1-3) | clean gravelly sand |

## TABLE 7 | SUMMARY OF TEST HOLE DATA, EASTERN PART OF THE CITY OF TIMMINS

Test Hole Number: TM-TH-13

Location: Macklem Township, Conc. B, Lot 2

Elevation: Approx. 970 feet (295 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-10 (0-3) | fine to medium sand |

Test Hole Number: TM-TH-14

Location: Macklem Township, Conc. B, Lot 1

Elevation: Approx. 1000 feet (305 m) a.s.l.

Date: August 6, 1981

| DEPTH Feet (metres) | DESCRIPTION |
|---|---|
| 0-2 (0-1) | medium to coarse gravel |
| 2-7 (1-2) | fine gravelly sand |

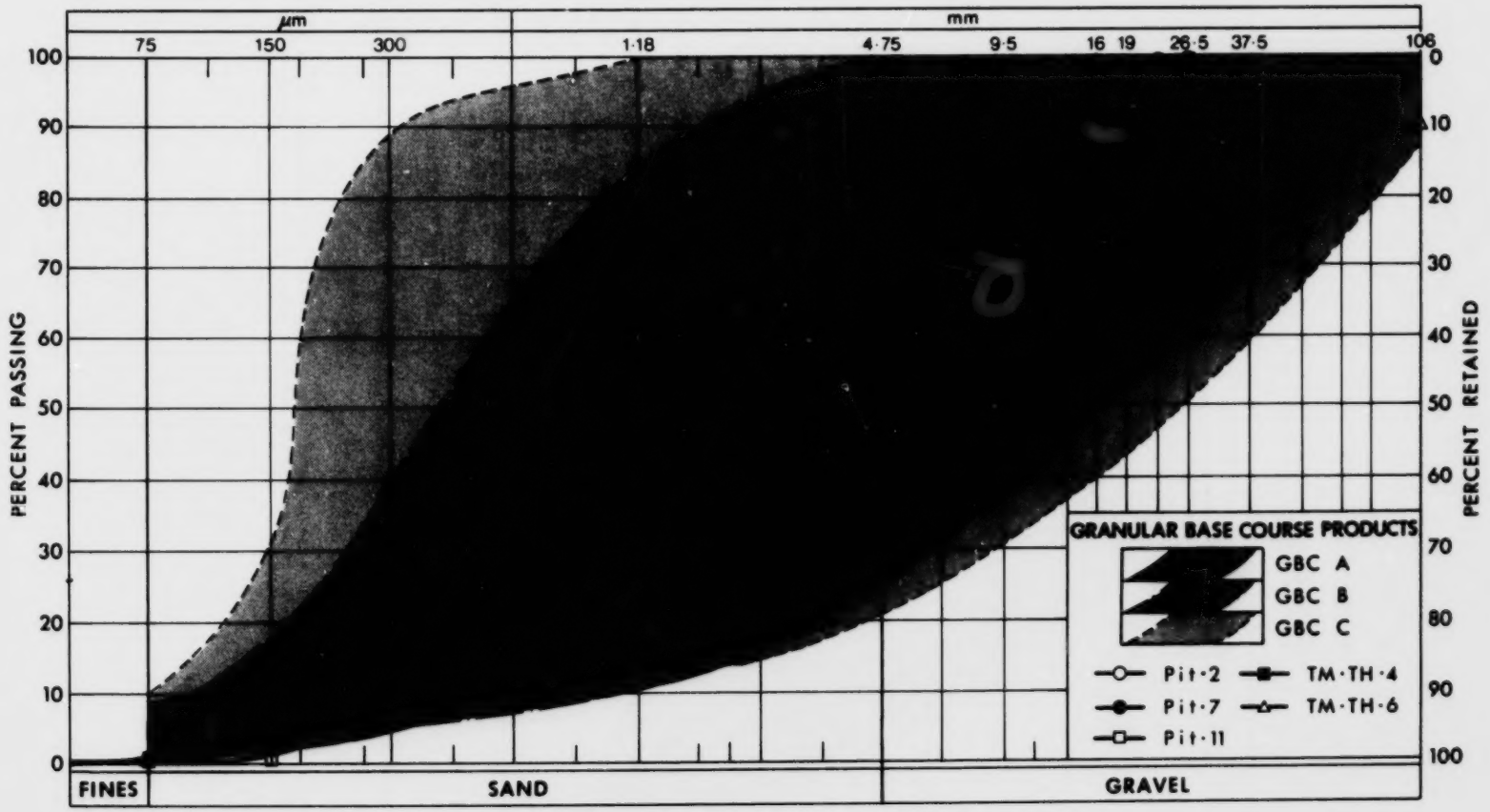



FIGURE 2a: AGGREGATE GRADING CURVES, EASTERN PART of the CITY of TIMMINS;

Based on analysis of the total aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1010, 1980).

NOTE: Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

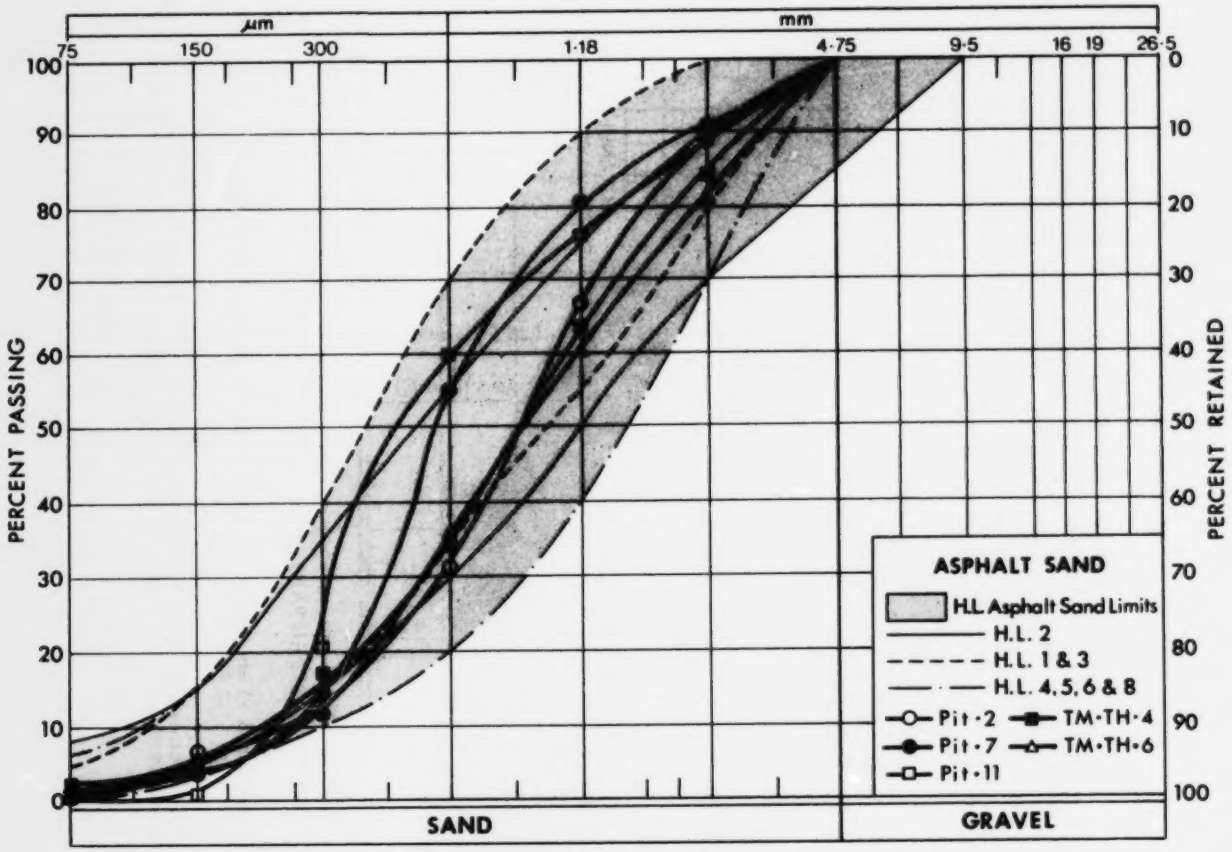



FIGURE 2b: AGGREGATE GRADING CURVES, EASTERN PART of the CITY of TIMMINS;

Based on analysis of the sand fraction of the aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1003, 1979).

NOTE:

Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

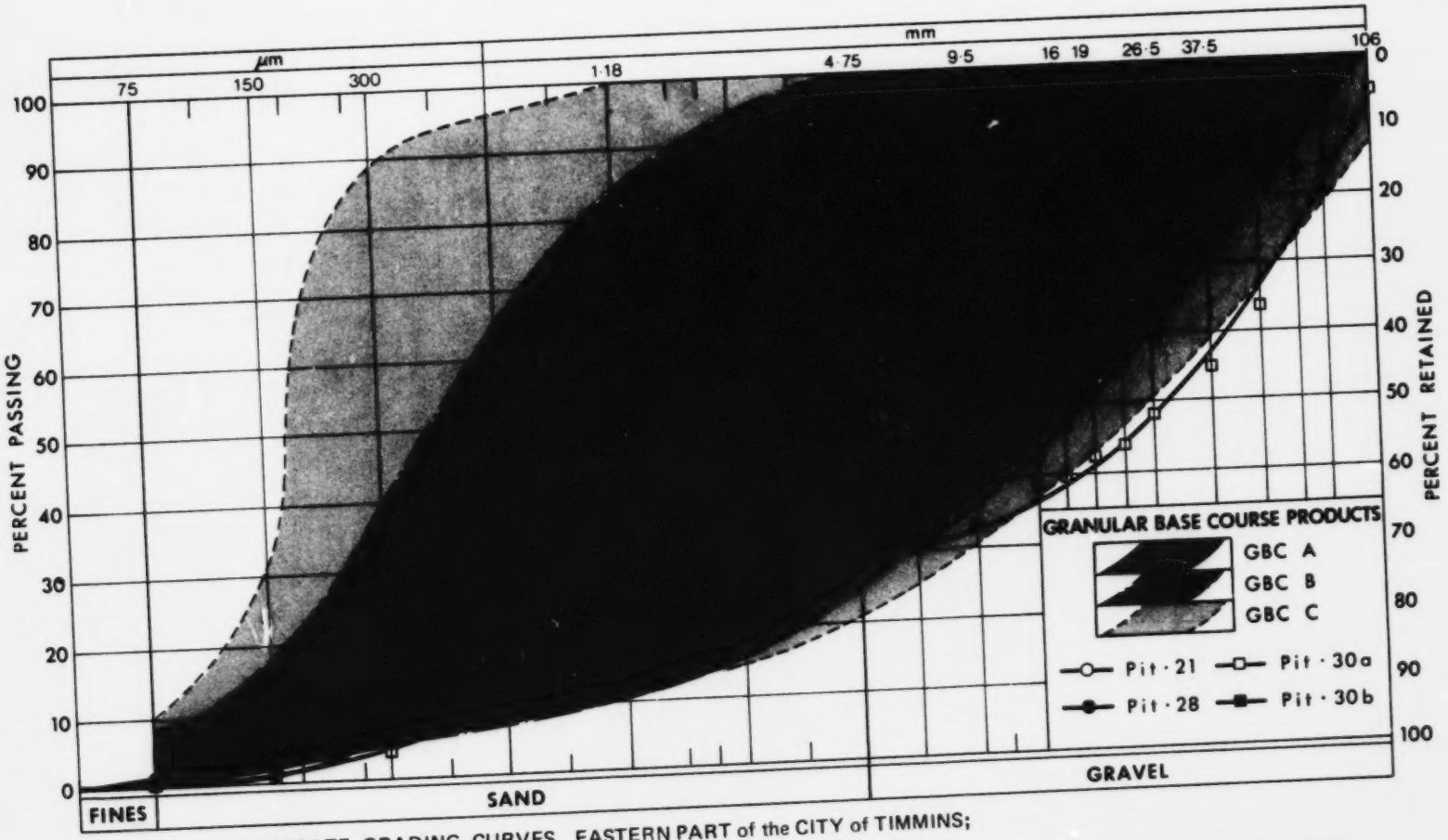



FIGURE 3a: AGGREGATE GRADING CURVES, EASTERN PART of the CITY of TIMMINS;

Based on analysis of the total aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1010, 1980).

NOTE: Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

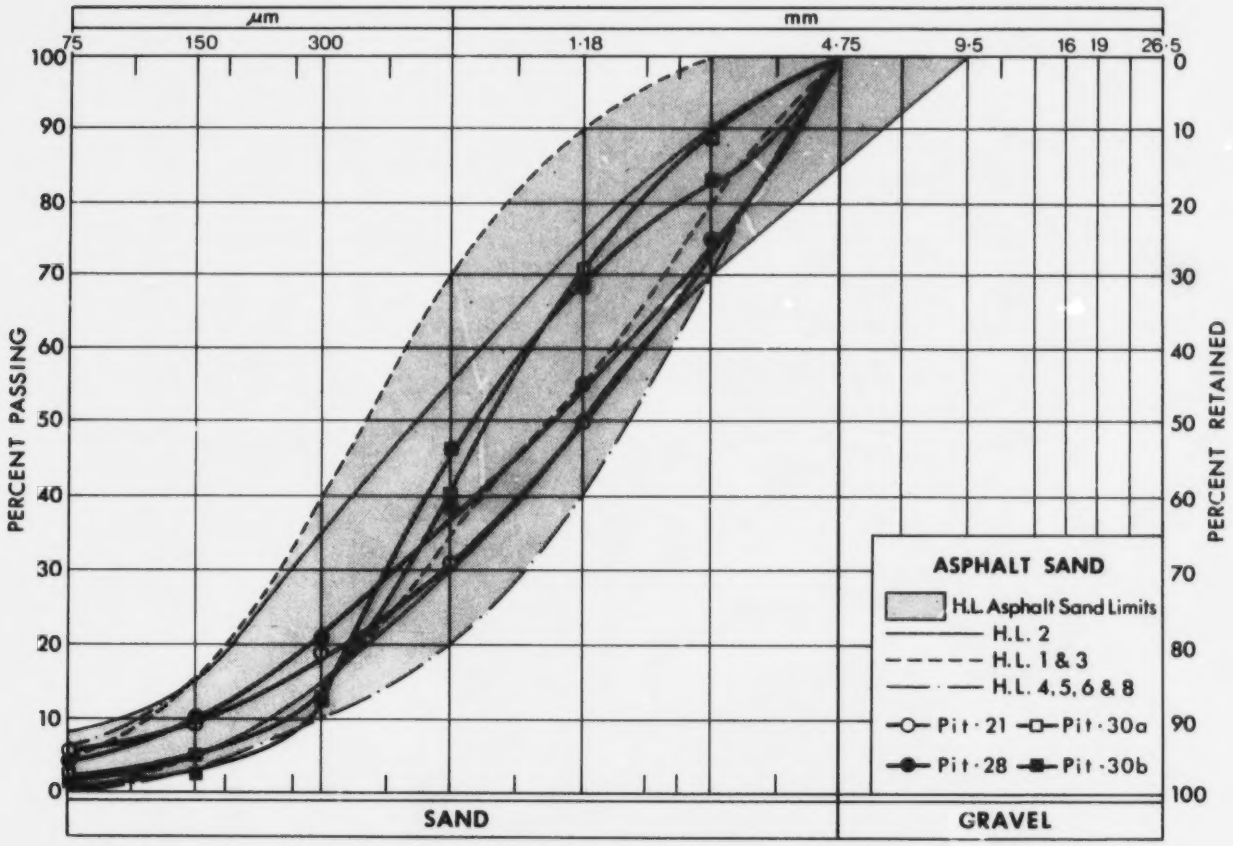



FIGURE 3b: AGGREGATE GRADING CURVES, EASTERN PART of the CITY of TIMMINS;

Based on analysis of the sand fraction of the aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1003, 1979).

NOTE:

Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

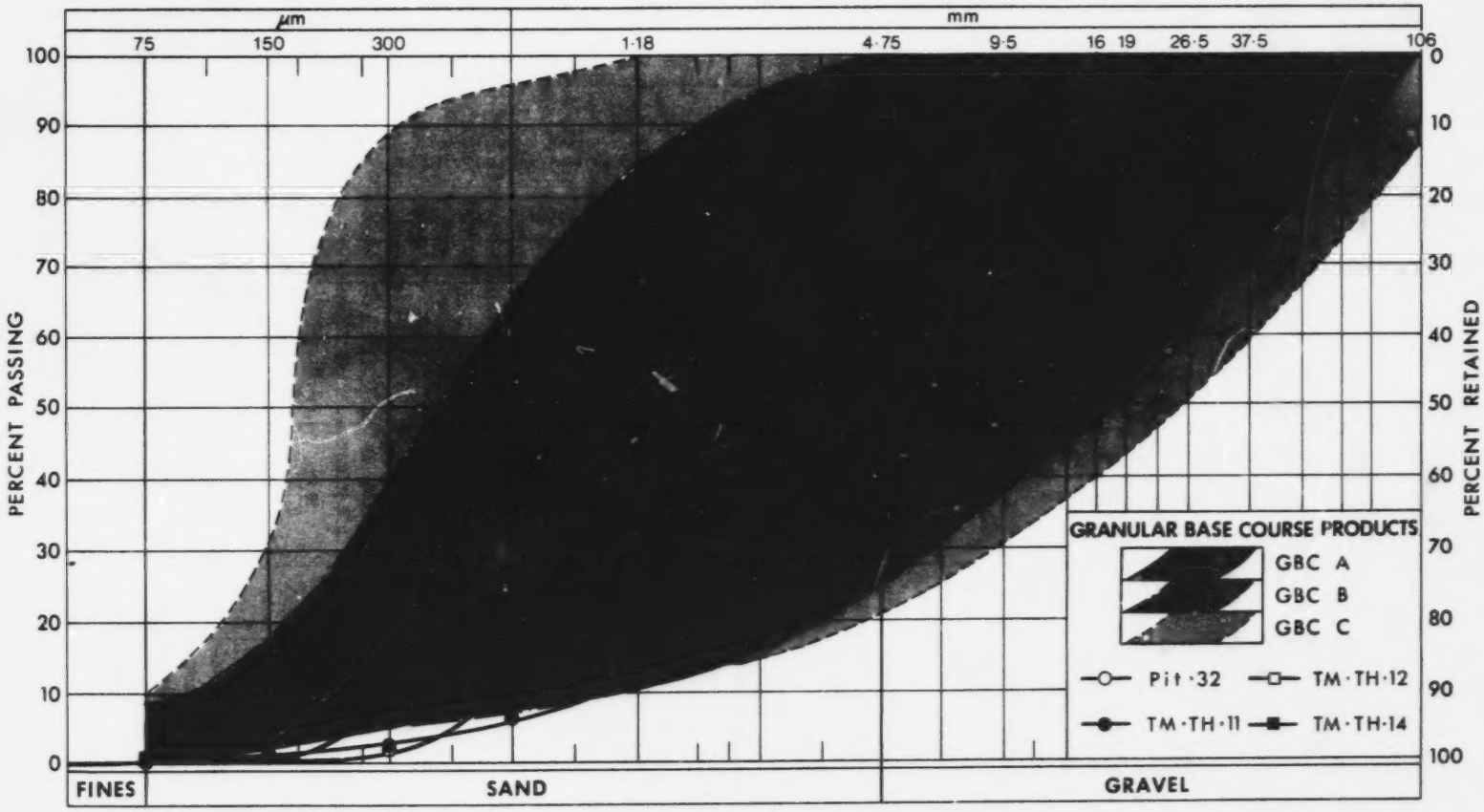



FIGURE 4a: AGGREGATE GRADING CURVES, EASTERN PART of the CITY of TIMMINS;

Based on analysis of the total aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1010, 1980).

NOTE: Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

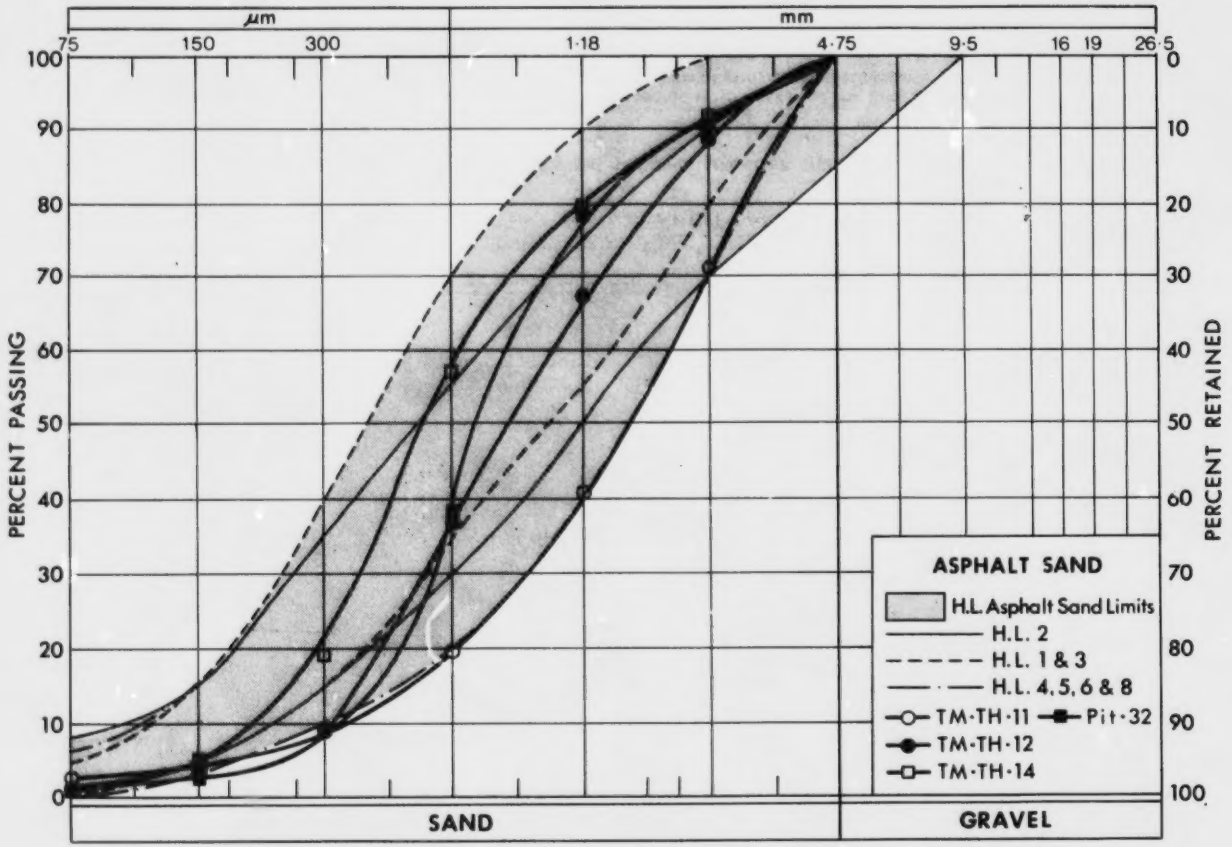



FIGURE 4b: AGGREGATE GRADING CURVES, EASTERN PART of the CITY of TIMMINS;

Based on analysis of the sand fraction of the aggregate contained in unprocessed samples (gradation envelopes adapted from M.T.C. Form 1003, 1979).

NOTE:

Information portrayed by grading curves refers strictly to a specific sample taken at the time of field investigation. Due to the inherent variability of sand and gravel deposits care should be exercised in extrapolating such information to the rest of the deposit.

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## APPENDIX B - GLOSSARY

### ABRASION RESISTANCE

Tests such as the Los Angeles Abrasion Test are used to measure the ability of aggregate to resist crushing and pulverizing under conditions similar to those encountered in processing and use. Measuring resistance is an important component in the evaluation of the quality and prospective uses of aggregate. Hard, durable material is preferred for road building.

### ABSORPTION CAPACITY

Related to the porosity of the rock types of which an aggregate is composed. Porous rocks are subject to disintegration when absorbed liquids freeze and thaw, thus decreasing the strength of the aggregate.

### AGGREGATE

Any hard, inert, construction material (sand, gravel, shells, slag, crushed stone or other mineral material) used for mixing in various-sized fragments with a cement or bituminous material to form concrete, mortar, etc., or used alone for road building or other construction. Synonyms include mineral aggregate and granular material.

### ALKALI-AGGREGATE REACTION

A chemical reaction between the alkalies of portland cement and certain minerals found in rocks used for aggregate. Alkali-aggregate reactions are undesirable because they can cause expansion and cracking of concrete. Although perfectly suitable for building stone and asphalt applications, alkali-reactive aggregates should be avoided for structural concrete uses.

### BLENDING

Required in cases of extreme coarseness, fineness or other irregularities in the gradation of unprocessed aggregate. Blending is done with approved sand-sized aggregate in order to satisfy the gradation requirements of the material.

### CLAST

An individual constituent, grain, or fragment of a sediment or rock, produced by the mechanical weathering of a larger rock mass. Synonyms include particle and fragment.

### CRUSHABLE AGGREGATE

Unprocessed gravel containing a minimum of 35 percent coarse aggregate larger than the No. 4 sieve (4.75 mm) as well as a minimum of 20 percent greater than the 26.5 mm sieve.

### DELETERIOUS LITHOLOGY

A general term used to designate those rock types which are chemically or physically unsuited for use as construction or road-building aggregates. Such lithologies as chert, shale, siltstone, and sandstone may deteriorate rapidly when exposed to traffic and other environmental conditions. Similarly, highly weathered, very porous and friable rock can restrict the quality of the aggregate.

### DOLOSTONE

A carbonate sedimentary rock consisting chiefly of the mineral dolomite and containing relatively little calcite (dolostone is also known as dolomite).

### DRIFT

A general term for all unconsolidated rock debris transported from one place and deposited in another; distinguished from underlying bedrock. In North America, glacial activity has been the dominant mode of transport and deposition of drift. Synonyms include overburden and surficial deposit.

### DRUMLIN

A low, smoothly rounded, elongated hill, mound, or ridge composed of glacial materials. These landforms were deposited beneath an advancing ice sheet, and were shaped by its flow.

## EOLIAN

Pertaining to the wind, especially with respect to landforms whose constituents were transported and deposited by wind activity. Sand dunes are an example of an eolian landform.

## FINES

A general term used to describe the size fraction of an aggregate which passes (is finer than) the No. 200 mesh screen (0.075 mm). Also described informally as "dirt", these particles are in the silt and clay size range.

## GNEISS

A coarse textured metamorphic rock with the minerals arranged in parallel streaks or bands, but lacking schistosity. Gneiss is relatively rich in feldspar. Other common minerals found in this rock include quartz, mica, amphibole and garnet.

## GRADATION

The proportion of material of each particle size, or the frequency distribution of the various sizes which constitute a sediment. The strength, durability, permeability and stability of an aggregate depend to a great extent on its gradation. The size limits for different particles are as follows:

| | |
|---|---|
| Boulders | more than 200 mm |
| Cobbles | 75-200 mm |
| Coarse Gravel | 26.5-75 mm |
| Fine Gravel | 4.75-26.5 mm |
| Coarse Sand | 2-4.75 mm |
| Medium Sand | 0.425-2 mm |
| Fine Sand | 0.075-0.425 mm |
| Silt, Clay | less than 0.075 mm |

## GRANITE

Is a coarse-grained light coloured rock that ordinarily has an even texture and is composed of quartz, and feldspar with either mica, hornblende or both.

## GRANULAR BASE COURSE

Components of the pavement structure of a road, which are placed on the subgrade and are designed to provide strength, stability, and drainage, as well as support for surfacing materials. Several types have been defined: Granular Base Course A consists of crushed and processed aggregate and has relatively stringent quality standards in comparison to Granular Base Course B and C which are usually pit-run or other unprocessed aggregate.

## HOT-LAID (OR ASPHALTIC) AGGREGATE

Bituminous, cemented aggregates used in the construction of pavements either as surface or bearing course (H.L. 1, 3, and 4), or as binder course (H.L. 2, 6, and 8) used to bind the surface course to the underlying granular base course.

## LITHOLOGY

The description of rocks on the basis of such characteristics as color, structure, mineralogic composition, and grain size. Generally, the description of the physical character of a rock.

## MAGNESIUM SULPHATE SOUNDNESS TEST

This test is designed to simulate the action of freezing and thawing on aggregates. Those aggregates which are susceptible will usually breakdown and give high losses in this test.

## MELTWATER CHANNEL

A drainage way, usually terraced, produced by water flowing away from a melting glacier margin.

## PETROGRAPHIC EXAMINATION

An aggregate quality test based on known field performance of various rock types. The test result is a Petrographic Number (P.N.). The higher the P.N. the lower the quality of aggregate.

## PLEISTOCENE

An Epoch of the recent geological past including the time from approximately 1.8 million years ago to 7000 years ago. Much of the Pleistocene was characterized by extensive glacial activity and is popularly referred to as the "Great Ice Age".

## POSSIBLE RESOURCE

Estimates of mineral aggregate material based largely on broad knowledge of the geologic

character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on assumed continuity or repetition for which there are reasonable geological indications.

### PRECAMBRIAN

The earliest geologic period extending from the consolidation of the earth's crust to the beginning of the Cambrian.

### SHALE

A fine-grained, sedimentary rock formed by the consolidation of clay, silt, or mud and characterized by well developed bedding planes, along which the rock breaks readily into thin layers. The term shale is also commonly used for fissile claystone, silstone, and mudstone.

### SOUNDNESS

The ability of the components of an aggregate to withstand the effects of various weathering processes and agents. Unsound lithologies are subject to disintegration caused by the expansion of absorbed solutions. This may seriously impair the performance of road-building and construction aggregates.

### TILL

Unsorted and unstratified rock debris, deposited directly by glaciers, and ranging in size from clay to large boulders.

### WISCONSINAN

Pertaining to the last glacial stage of the Pleistocene Epoch in North America. It began approximately 100,000 years ago and ended approximately 7000 years ago. The glacial deposits and landforms of Ontario are predominantly the result of glacial activity during the Wisconsinan Stage.

# APPENDIX C - GEOLOGY OF SAND AND GRAVEL DEPOSITS

The type, distribution, and extent of sand and gravel deposits in Ontario are the result of extensive glacial and glacially influenced activity in Wisconsinan time during the Pleistocene Epoch, approximately 100,000 to 7000 years ago. The deposit types reflect the different depositional environments that existed during the melting and retreat of the continental ice masses, and they can readily be differentiated on the basis of their morphology, structure, and texture. The deposit types are described below.

## GLACIOFLUVIAL DEPOSITS

These deposits can be divided into two broad categories: Those that were formed in contact with (or in close proximity to) glacial ice, and those that were deposited by meltwaters carrying materials beyond the ice margin.

### ICE-CONTACT TERRACES (ICT)

These are glaciofluvial features deposited between the glacial margin and a confining topographic high, such as the side of a valley. The structure of the deposits may be similar to that of outwash deposits, but in most cases the sorting and grading of the material is more variable and the bedding is discontinuous due to extensive slumping. The probability of locating large amounts of crushable aggregate is moderate, and extraction may be expensive due to the variability of the deposits both in terms of quality and grain size distribution.

### KAMES (K)

Kames are defined as mounds of poorly sorted sand and gravel deposited by meltwater in depressions or fissures on the ice surface or at its margin. During glacial retreat, the melting of supporting ice causes collapse of the deposits, producing internal structures characterized by bedding discontinuities. The deposits consist mainly of irregularly bedded and crossbedded, poorly sorted sand and gravel. The present forms of the deposits include single mounds, linear ridges (crevasse fillings) or complex groups of landforms. The latter are occasionally described as "undifferentiated ice-contact stratified drift" (IC) when detailed subsurface information is unavailable. Since kames commonly contain large amounts of fine-grained material and are characterized by considerable variability, there is generally a low to moderate probability of discovering large amounts of good-quality, crushable aggregate. Extractive problems encountered in these deposits are mainly the excessive variability of the aggregate and the presence of excess fines (silt- and clay-sized particles).

### ESKERS (E)

Eskers are narrow, sinuous ridges of sand and gravel deposited by meltwaters flowing in tunnels within or at the base of glaciers, or in channels on the ice surface. Eskers vary greatly in size. Many, though not all eskers consist of a central core of poorly sorted and stratified gravel characterized by a wide range in grain size. The core material is often draped on its flanks by better sorted and stratified sand and gravel. The deposits have a high probability of containing a large proportion of crushable aggregate, and since they are generally built above the surrounding ground surface, are convenient extraction sites. For these reasons esker deposits have been traditional aggregate sources throughout Ontario, and are significant components of the total resources of many areas.

Some planning constraints and opportunities are inherent in the nature of the deposits. Because of their linear nature, the deposits commonly extend across several property boundaries leading to unorganized extractive development at numerous small pits. On the other hand, because of their form, eskers can be easily and inexpensively extracted and are amenable to rehabilitation and sequential land use.

### UNDIFFERENTIATED ICE-CONTACT STRATIFIED DRIFT (IC)

This designation may include deposits from several ice-contact, depositional environments which usually form extensive, complex landforms. It is not feasible to identify individual areas of coarse-grained material within such deposits due to their lack of continuity and grain-size variability. They are given a qualitative rating based on existing pit and other subsurface data.

### OUTWASH (OW)

Outwash deposits consist of sand and gravel laid down by meltwaters beyond the margin of the glacier. They occur as sheets or as terraced valley fills (valley trains) and may be very large in extent and thickness. Well developed outwash deposits have good horizontal bedding and are uniform in grain size distribution. Outwash deposited near the glacier's margin is much more variable in texture and structure. The probability of locating useful crushable aggregates in outwash deposits is moderate to high depending on how much information on size, distribution and thickness is available.

### ALLUVIUM (AL)

Alluvium is a general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during postglacial time by a stream as sorted or semi-sorted sediment, on its bed or on its floodplain. The probability of locating large amounts of crushable aggregate in alluvial deposits is low, and it has generally low value due to the presence of excess silt- and clay-sized material. There are no large postglacial alluvium deposits in Ontario.

## GLACIOLACUSTRINE DEPOSITS

### GLACIOLACUSTRINE BEACH DEPOSITS (LB)

These are a relatively narrow, linear feature formed by wave action at the shores of glacial lakes that existed at various times during the deglaciation of Ontario. Well developed lacustrine beaches are usually less than 20 feet (6 m) thick. The aggregate is well sorted and stratified and sand-sized material commonly predominates. The composition and size distribution of the deposit depends on the nature of the underlying material. The probability of obtaining crushable aggregate is high when the material is developed from coarse-grained materials such as a stony till, and low when developed from fine-grained materials. Beaches are relatively narrow, linear deposits, so that extractive operations are often numerous and extensive.

### GLACIOLACUSTRINE DELTAS (LD)

These features were formed where streams or rivers of glacial meltwater flowed into lakes and deposited their suspended sediment. In Ontario such deposits tend to consist mainly of sand and abundant silt. However, in near-ice and ice-contact positions, coarse material may be present. Although deltaic deposits may be large, the probability of obtaining coarse material is generally low.

### GLACIOLACUSTRINE PLAIN (LP)

The nearly level surface marking the floor of an extinct glacial lake. The sediments which form the plain are predominantly fine to medium sand, silt, and clay, and were deposited in relatively deep water. Lacustrine deposits are generally of low value as aggregate sources due to their fine grain size and lack of crushable material. In some aggregate-poor areas, lacustrine deposits may constitute valuable sources of fill and some granular base course aggregate.

## GLACIAL DEPOSITS

### END MORAINES (EM)

These are belts of glacial drift deposited at, and parallel to, glacier margins. They commonly consist of ice-contact stratified drift and in such instances are usually called kame moraines. Kame moraines commonly result from deposition between two glacial lobes (interlobate moraines). The probability of locating aggregates within such features is moderate to low. Exploration and development costs are high. Moraines may be very large and contain vast aggregate resources, but the location of the best resource areas within the moraine is usually poorly defined.

## EOLIAN DEPOSITS

### WINDBLOWN FORMS (WD)

Windblown deposits are those formed by the transport and deposition of sand by winds. The form of the deposits ranges from extensive, thin layers to well developed linear and crescentic ridges known as dunes. Most windblown deposits in Ontario are derived from, and deposited on, pre-existing lacustrine sand plain deposits. Windblown sediments are almost invariably composed of fine to coarse sand and are usually well sorted. The probability of locating crushable aggregate in windblown deposits is very low.

## APPENDIX D - GEOLOGY OF BEDROCK DEPOSITS
## (Modified after Leahy 1971 and Pyke 1980a, b)

### METAVOLCANICS (EARLY PRECAMBRIAN)

Rock Type A - Intermediate and Mafic Metavolcanics: consist of mafic metavolcanic flows and metavolcanic fragmental rocks. For the most part, the mafic flows are massive or pillowed. Basalt is a common mafic metavolcanic rock. The metavolcanic fragmental rocks range from fine-grained tuffs to coarse agglomerates. On fresh surfaces the intermediate and mafic metavolcanics are generally shades of green.

Rock Type B - Felsic Metavolcanics: include rhyolites and rhyodacites along with a variety of felsic pyroclastic rocks. They are usually grey to green on fresh surfaces and weather buff to light grey.

### METASEDIMENTS (EARLY PRECAMBRIAN)

Rock Type C: the older metasediments consist dominantly of interlayered greywacke, siltstone and lesser conglomerate. The greywackes are usually fine to medium grained and are light grey-brown on weathered surfaces. The younger metasediments consist chiefly of coarse greywackes and conglomerates. Both varieties of metasediments also contain slate and argillite.

### METAMORPHOSED MAFIC AND ULTRAMAFIC ROCKS (EARLY PRECAMBRIAN)

Rock Type D - Metamorphosed Ultramafic Rocks: are composed largely of dunites. The dunites consist of densely packed olivine grains and are typically bluish black and rarely light green on fresh surfaces. On weathered surfaces they are light to medium grey or orange-brown.

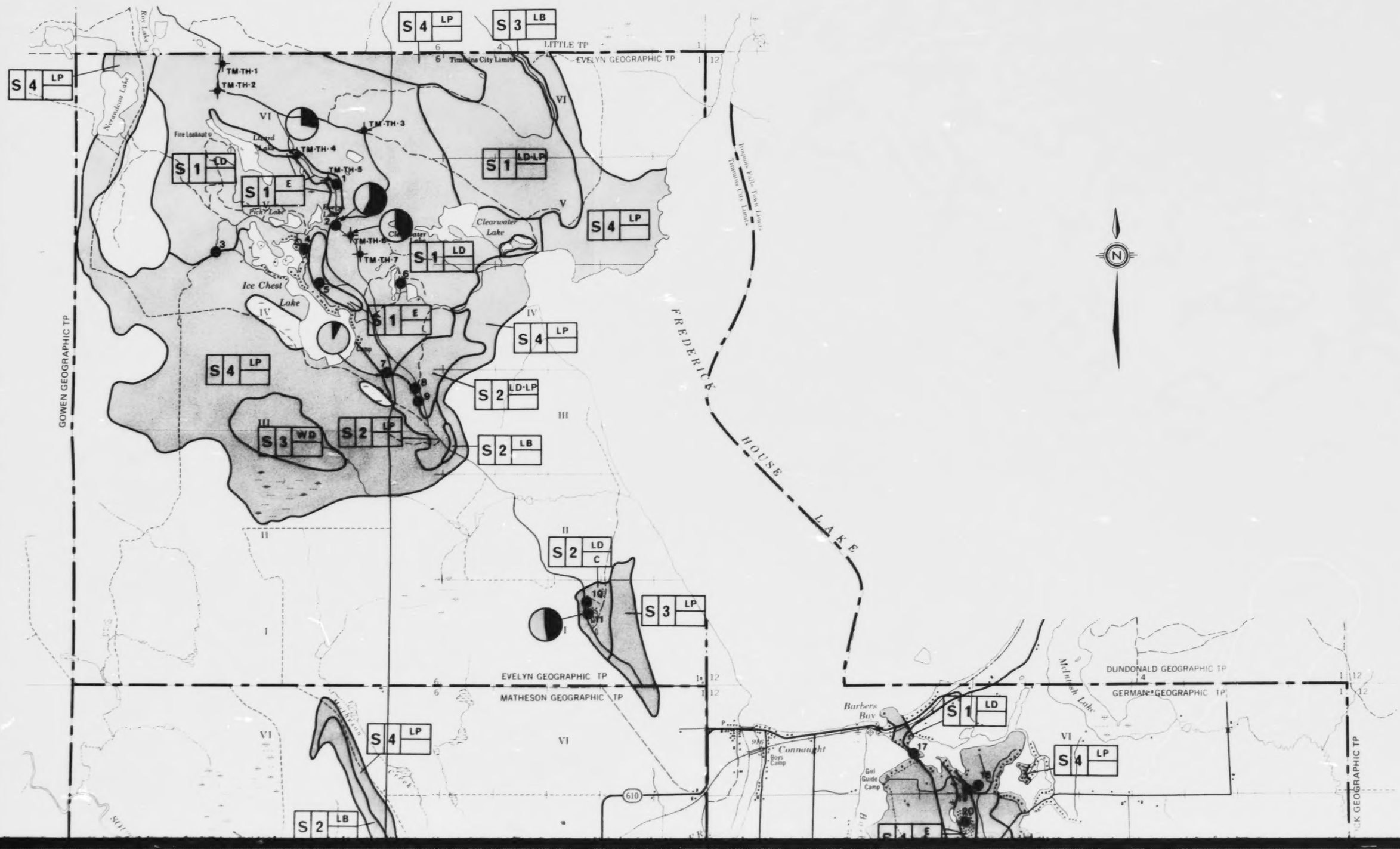
Rock Type E - Metamorphosed Mafic Rocks: consist predominantly of gabbro and diorite. Gabbro is a coarse-grained basic rock. Diorite is also coarse grained but is intermediate in composition.

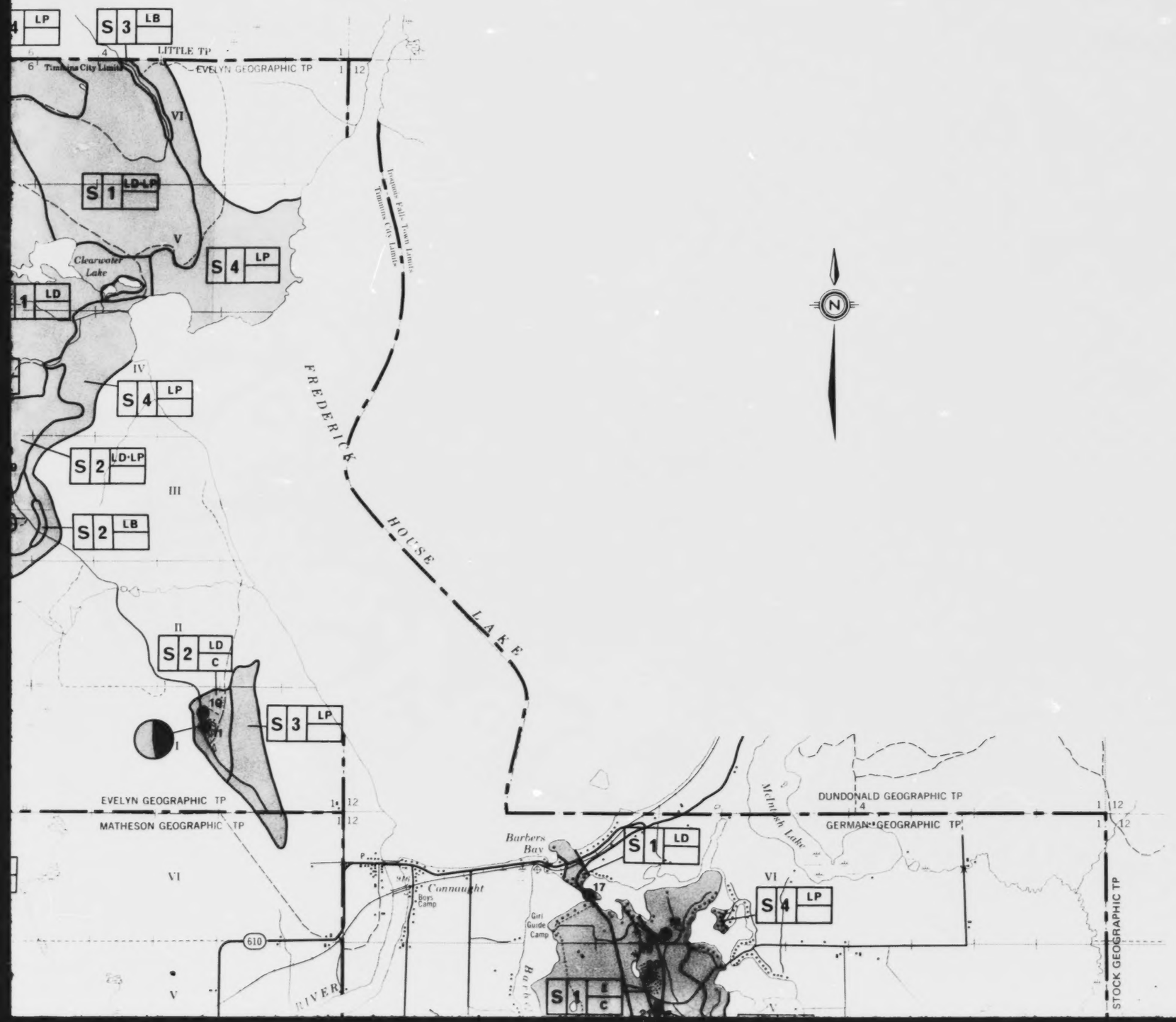
### FELSIC INTRUSIVE ROCKS (EARLY PRECAMBRIAN)

Rock Type F: consists dominantly of quartz-feldspar porphyries. They are light grey to buff weathering, moderately to strongly foliated and light green-grey on fresh surfaces.

### MAFIC INTRUSIVE ROCKS (EARLY TO LATE PRECAMBRIAN)

Rock Type G: consists of both quartz-bearing and olivine-bearing diabase dikes. The diabase is massive and weathered surfaces are grey to orange-brown.


S 4 LP
S 3 LB
S 1 LD
S 1 LD-LP
S 1 E
S 4 LP
S 1 LD
S 1 E
S 4 LP
S 4 LP
S 2 LD-LP
S 3 WD
S 2 LP
S 2 LB
S 2 LD C
S 3 LP
S 4 LP
S 1 LD
S 4 LP
S 2 LB
TM-TH-1
TM-TH-2
TM-TH-3
TM-TH-4
TM-TH-5
TM-TH-6
TM-TH-7
Timmins City Limits
LITTLE TP
EVELYN GEOGRAPHIC TP
MATHESON GEOGRAPHIC TP
GOWEN GEOGRAPHIC TP
DUNDONALD GEOGRAPHIC TP
GERMANIA GEOGRAPHIC TP
Iroquois Falls Town Limits
Timmins City Limits
Roy Lake
Nevandean Lake
Fire Lookout
Lizard Lake
Pick Lake
Clearwater Lake
Ice Chest Lake
Barbers Bay
McIntosh Lake
Connaught Boys Camp
Girl Guide Camp
FREDERICK HOUSE LAKE
610
N




Ministry of Natural Resources
Ontario

Hon. Alan W. Pope
Minister

W.T. Foster
Deputy Minister

# ONTARIO GEOLOGICAL SURVEY

## AGGREGATE RESOURCES INVENTORY

## EASTERN PART OF THE
## CITY OF TIMMINS
## COCRANE DISTRICT

EVELYN, GERMAN, MACKLEM, AND MATHESON
GEOGRAPHIC TOWNSHIPS

## MAP 1
## DISTRIBUTION OF SAND AND GRAVEL DEPOSITS

Scale 1: 50 000

Mile 1 0 1 Mile

Metres 1000 0 1 Kilometre

NTS Reference: 42 A/7 42 A/10 42 A/11

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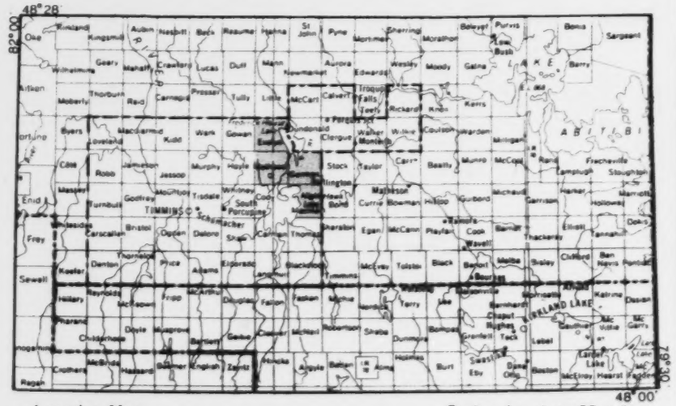


Location Map

Scale: 1 inch to 25 miles

### LEGEND

(Some map units and symbols may not apply to this map.)

**MAP UNITS**

Gravel deposit.

Sand deposit.

LITTLE TP
EVELYN GEOGRAPHIC TP
Timmins City Limits
Roy Lake
Nerandeau Lake
Fire Lookout
Lizard Lake
Pick Lake
Beetle Lake
Clearwater Lake
Ice Chest Lake
Camp
Iroquois Falls-Town Limits
Timmins City Limits
FREDERICK HOUSE LAKE
GOWEN GEOGRAPHIC TP
EVELYN GEOGRAPHIC TP
MATHESON GEOGRAPHIC TP
Barbers Bay
Connaught
Boys Camp
Girl Guide Camp
McIntosh Lake
DUNDONALD GEOGRAPHIC TP
GERMAN GEOGRAPHIC TP
STOCK GEOGRAPHIC TP
610
I
II
III
IV
V
VI
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
P
2
3
4
6
12

Ministry of Natural Resources
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Minister

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Deputy Minister

# ONTARIO GEOLOGICAL SURVEY

## AGGREGATE RESOURCES INVENTORY

## EASTERN PART OF THE

# CITY OF TIMMINS

## COCHRANE DISTRICT

EVELYN, GERMAN, MACKLEM, AND MATHESON

GEOGRAPHIC TOWNSHIPS

# MAP 2
# SELECTED SAND AND GRAVEL RESOURCE AREAS

Scale 1: 50 000

Mile 1 0 1 Mile

Metres 1000 0 1 Kilometre

**NTS Reference: 42 A/7 42 A/10 42 A/11**

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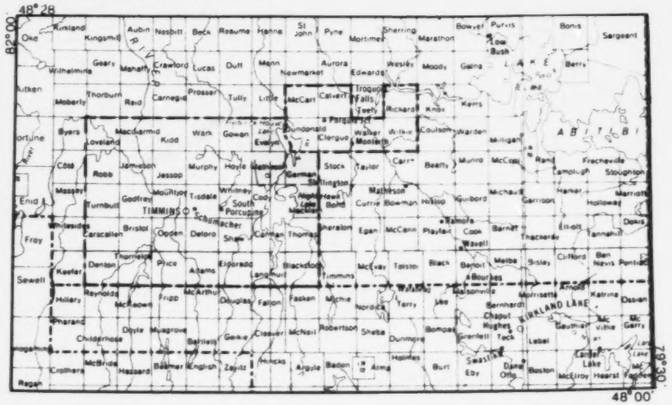



Location Map

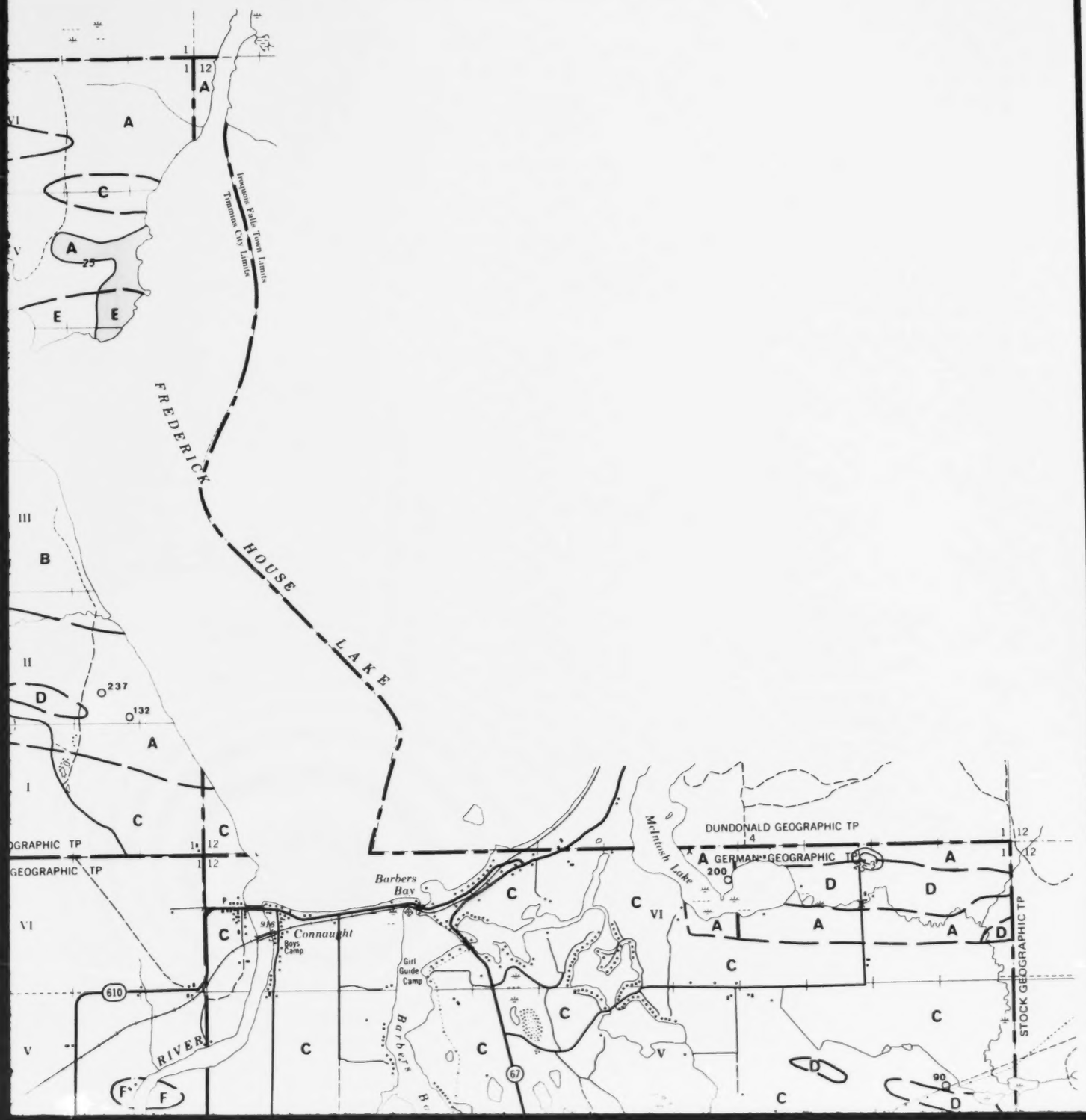
Scale: 1 inch to 25 miles

## LEGEND

### MAP UNITS

(1) Selected sand and gravel resource area, primary significance; deposit number see Table 3

LITTLE TP
EVELYN GEOGRAPHIC TP
Timmins City Limits
Roy Lake
Nerondeus Lake
Fire Lookout
341
Lizard Lake
184
238
Fish Lake
Evelyn Lake
Clearwater Lake
Ice Chest Lake
Camp
79
276
237
132
110
147
104
92
45
Iroquois Falls Town Limits
Timmins City Limits
FREDERICK HOUSE LAKE
GOWEN GEOGRAPHIC TP
EVELYN GEOGRAPHIC TP
MATHESON GEOGRAPHIC TP
Matheson Creek
SOUTH RIVER
Barbers Bay
Connaught Boys Camp
Girl Guide Camp
Barbers Ha
610
67
DUNDONALD GEOGRAPHIC TP
GERMAN GEOGRAPHIC TP
200
Mcintosh Lake
STOCK GEOGRAPHIC TP
90
25

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# ONTARIO GEOLOGICAL SURVEY

## AGGREGATE RESOURCES INVENTORY

## EASTERN PART OF THE

# CITY OF TIMMINS

## COCHRANE DISTRICT

EVELYN, GERMAN, MACKLEM, AND MATHESON
GEOGRAPHIC TOWNSHIPS

## MAP 3
## BEDROCK RESOURCES

Scale 1: 50 000

Mile 1 0 1 Mile

Metres 1000 0 1 Kilometre

NTS Reference: 42 A/7 42A/10 42 A/11

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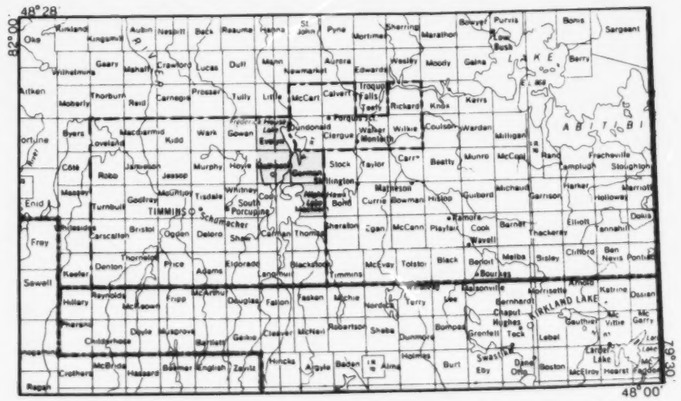


Location Map

Scale: 1 inch to 25 miles

## LEGEND

### DRIFT THICKNESS

Bedrock outcrop: areas of exposed bedrock partially covered by an irregular veneer of drift. Drift thickness is generally less than 3 feet (1 m); see Table 4.

EVELYN GEOGRAPHIC TP
MATHESON GEOGRAPHIC TP
DUNDONALD GEOGRAPHIC TP
GERMAN GEOGRAPHIC TP
HOYLE GEOGRAPHIC TP
MATHESON GEOGRAPHIC TP
CODY GEOGRAPHIC TP
GERMAN GEOGRAPHIC TP
MACKLEM GEOGRAPHIC TP
BLACK RIVER-MATHESON TP
STOCK GEOGRAPHIC TP
Timmins City Limits
Surveyed Line
Gas Pipeline
PROVINCIAL PARK
KETTLE LAKES
Night Hawk Centre
Keyson
Hoyle
Dugwell
Barbers Bay
Charland Lake
Hughes Lake
Heart L.
Key L.
Spring L.
Green L.
Tamarack L.
Pine L.
Irrigation Lake
Bullfrog Lake
Kettle L.
Leg of Lamb Lake
Deer Lake
Island Lake
Perton Lake
Leece L.
Legare Lake
Gibson Lake
Boy Scout L.
Boy Scout Camp
Girl Guide Camp
Community Rec. Camp
Marina
Pumping Station
Dump
Zinc Plant
Sta
Conservation
Plant
BM 1003
BM 1001
TM-TH-8
TM-TH-9
610
101
67
RIVER
SOUTH
PORCUPINE
FREDERICK
HOUSE
LAKE
HOUSE
BAY
I
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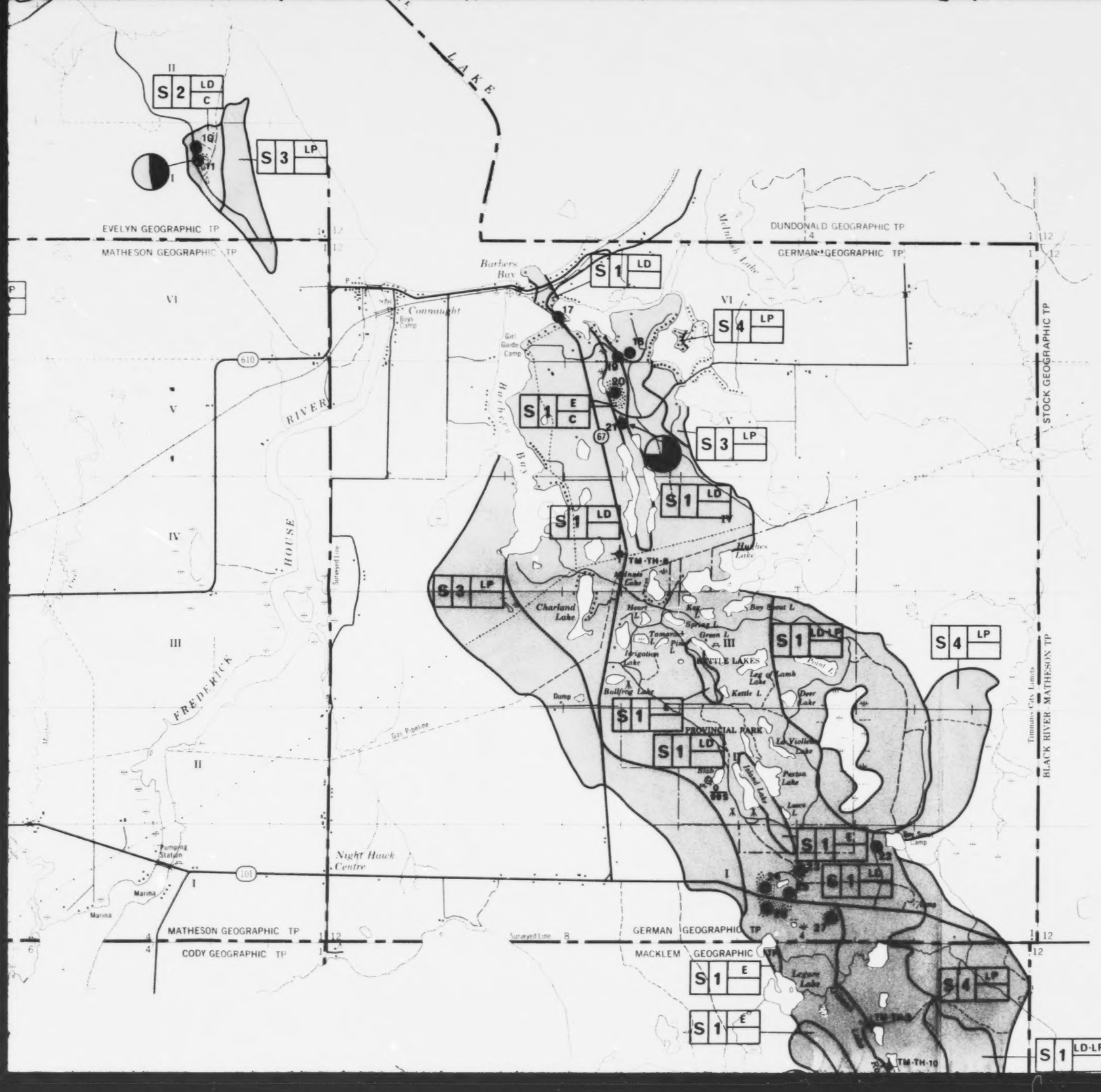
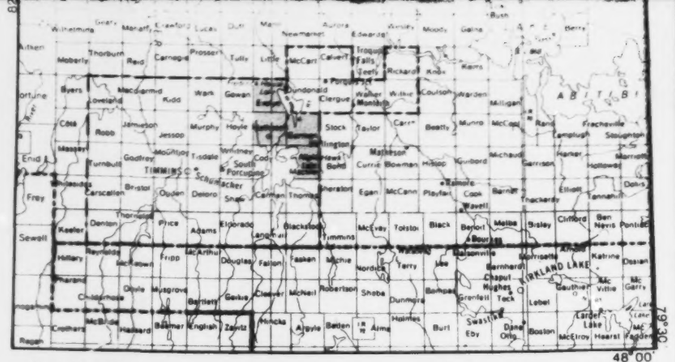
S 1 LD
S 1 E
S 1 LD LP
S 1 E C
S 2 LD
S 2 LD C
S 2 LB
S 3 LP
S 4 LP




Location Map

Scale: 1 inch to 25 miles

## LEGEND

**(Some map units and symbols may not apply to this map.)**

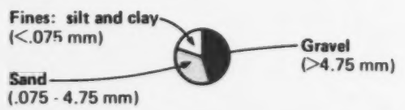
### MAP UNITS

- Gravel deposit.
- Sand deposit.
- Gravel overlain by other surficial material.
- Sand overlain by other surficial material.
- Other surficial deposits or exposed bedrock.

### SYMBOLS

- Geological and aggregate thickness boundary of sand and gravel deposits.
- Municipal, township boundary.
- 2 — Sand or gravel pit; identification number; see Table 2.
- Extracted area of sand and gravel pits.
- TM-TH-2 — Test hole location; identification number; see Table 7.
- 6 / 23 G — Selected water well location. Layers of materials are described by: reported thickness of material (in feet); reported type of material (number only - overburden, G- gravel, S - sand, C - clay, T - till, B - boulders, Bk - bedrock).
- G 1 IC C-O — Deposit symbol; see below.
- Texture symbol; see below; see Figures **2,3 &4**.

### TEXTURE SYMBOL




The Texture Symbol provides quantitative assessment of the grain size distribution at a sampled location. The relative amounts of gravel, sand, silt and clay in the sampled material are shown graphically by the subdivision of a circle into proportional segments. The above example shows a hypothetical

HOUSE LAKE

EVELYN GEOGRAPHIC TP

MATHESON GEOGRAPHIC TP

DUNDONALD GEOGRAPHIC TP

GERMAN GEOGRAPHIC TP

STOCK GEOGRAPHIC TP

HOYLE GEOGRAPHIC TP

MATHESON GEOGRAPHIC TP

CODY GEOGRAPHIC TP

GERMAN GEOGRAPHIC TP

MACKLEM GEOGRAPHIC TP

BLACK RIVER - MATHESON TP

Timmins City Limits

PORCUPINE RIVER

FREDERICK HOUSE RIVER

Barbers Bay

Connaught Boys Camp

Girl Guide Camp

McIntosh Lake

Hughes Lake

McInnis Lake

Charland Lake

Heart L.

Key L.

Boy Scout L.

Spring L.

Tamarack L.

Green L.

Pine L.

Irrigation Lake

KETTLE LAKES

Bullfrog Lake

Kettle L.

Leg of Lamb Lake

Deer Lake

Dump

PROVINCIAL PARK

La Violette Lake

Slab L.

Island Lake

Peston Lake

Leece L.

Boy Scout Camp

Gas Pipeline

Surveyed Line

Night Hawk Centre

Pumping Station

Marina

Dugual

Matheson Creek

Plant Dump

Zinc Plant

Concentrator

Keyson

Hoyle

BM 964

BM 961

Legare Lake

610

101

67

TP

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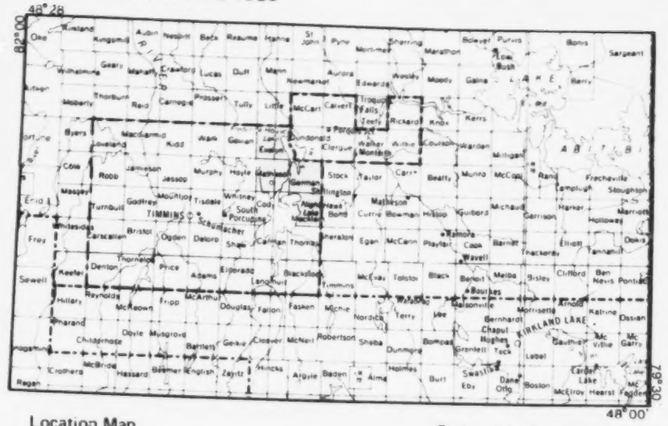


Location Map

Scale: 1 inch to 25 miles

## LEGEND

### MAP UNITS

- (1) Selected sand and gravel resource area, primary significance; deposit number; see Table 3.
- Selected sand and gravel resource area, secondary significance.
- Selected sand and gravel resource area, tertiary significance.

### SYMBOLS (Some symbols may not apply to this map)

- Geological and aggregate thickness boundary of sand and gravel deposits.
- Municipal, township boundary.
- ●2 Sand or gravel pit; identification number; see Table 2.
- Extracted area of sand and gravel pits.

## SOURCES OF INFORMATION

Base map by Surveys and Mapping Branch, Ontario Ministry of Natural Resources.

Aggregate suitability data from the Engineering Materials Office, Ontario Ministry of Transportation and Communications.

Geology by: O.L. Hughes, 1960a, b.
J.A. Richard, 1981.

Additional fieldwork by the staff of the Aggregate Assessment Office.

Terrain Evaluation by: H.A. Lee, 1979a,b,c,d.

Compilation and Drafting by: Staff of the Aggregate Assessment Office.

This map is to accompany O.G.S. Aggregate Resources Inventory Paper 90.

This map is published with the permission of E. G. Pye, Director, Ontario Geological Survey.
Issued 1983.

EVELYN GEOGRAPHIC TP
MATHESON GEOGRAPHIC TP
DUNDONALD GEOGRAPHIC TP
GERMAN GEOGRAPHIC TP
MACKLEM GEOGRAPHIC TP
CODY GEOGRAPHIC TP
HOYLE GEOGRAPHIC TP
STOCK GEOGRAPHIC TP
BLACK RIVER-MATHESON TP
LAKE
SOUTH PORCUPINE
RIVER
Matheson Creek
McIntosh Lake
Barbers Bay
Connaught
Boys Camp
Girl Guide Camp
Harpers Bay
Hughes Lake
Charland Lake
Heart L.
Keg L.
Spruce L.
Boy Scout L.
Tamarack L.
Green L.
Pine L.
Irrigation Lake
KETTLE LAKES
Leg of Lamb Lake
Kettle L.
Deer Lake
Bullfrog Lake
Dump
PROVINCIAL PARK
Gullette Lake
Slab L.
Island Lake
Pexton Lake
Leece L.
Boy Scout Camp
Timmins City Limits
Legare Lake
Dugwal
Keyson
Hoyle
Plant
Zinc Plant
Sta
BM 964
Gas Pipeline
Pumping Station
Marina
Night Hawk Centre
Surveyed Line
FREDERICK HOUSE
Mathesson Creek
610
101
67
200
70
64
147
104
92
45
110
276
237
132
135
148
175
100
90
25
30

NTS Reference: 42 A/7 42A/10 42 A/11

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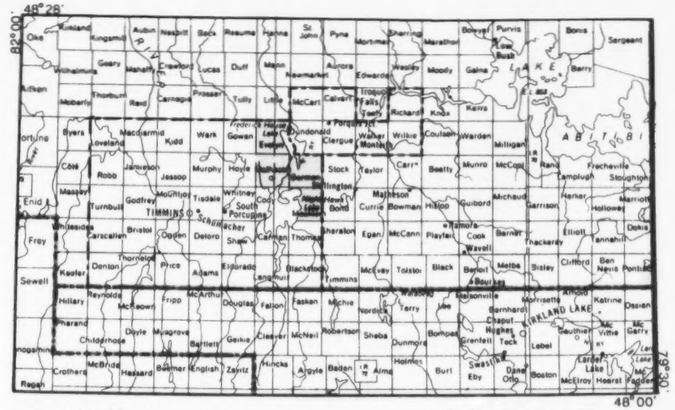


Location Map Scale: 1 inch to 25 miles

## LEGEND

### DRIFT THICKNESS

Bedrock outcrop: areas of exposed bedrock partially covered by an irregular veneer of drift. Drift thickness is generally less than 3 feet (1 m); see Table 4.

Bedrock drift complex: areas of bedrock covered by an irregular veneer of drift. Drift thickness is generally less than 25 feet (8 m) but may exceed 65 feet (20 m) in bedrock depressions. Isolated bedrock outcrops may occur; see Table 4.

Drift-covered bedrock: areas of bedrock generally covered by more than 25 feet (8 m) of drift. The areas contain isolated outcrops and small areas of thin drift as well as local areas of considerably thicker drift.

### BEDROCK UNITS (Some bedrock units may not apply to this map.)

**Metavolcanics**

A Intermediate and Mafic Metavolcanics

B Felsic Metavolcanics

**Metasediments**

C Greywacke, Siltstone, Slate, Argillite, and Pebble Conglomerate

**Metamorphosed Ultramafic and Mafic Rocks**

D Metamorphosed Ultramafic Rocks

E Metamorphosed Mafic Rocks

**Felsic Intrusive Rocks**

F Quartz-Feldspar Porphyries

**Mafic Intrusive Rocks**

G Diabase Dikes

### SYMBOLS (Some symbols may not apply to this map)

(1) Selected bedrock resource area; deposit number; see Table 6.

Geological boundary.

25 Drift thickness contour (3 foot and 25 foot contours are shown).

Municipal, township boundary.

Q2 Quarry; identification number; see Table 5.

x Isolated bedrock outcrop.

## SOURCES OF INFORMATION

Base map by Surveys and Mapping Branch, Ontario Ministry of Natural Resources.

Aggregate suitability data from the Engineering Materials Office, Ontario Ministry of Transportation and Communications.

Selected water well data from the Ontario Ministry of the Environment.

Test hole data from Aggregate Assessment Office, Ontario Geological Survey, Ontario Ministry of Natural Resources; Ontario Ministry of Transport and Communications; other sources (see Table 7).

Geology by: O. L. Hughes, 1960 a, b.
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Additional fieldwork by the Staff of the Aggregate Assessment Office.

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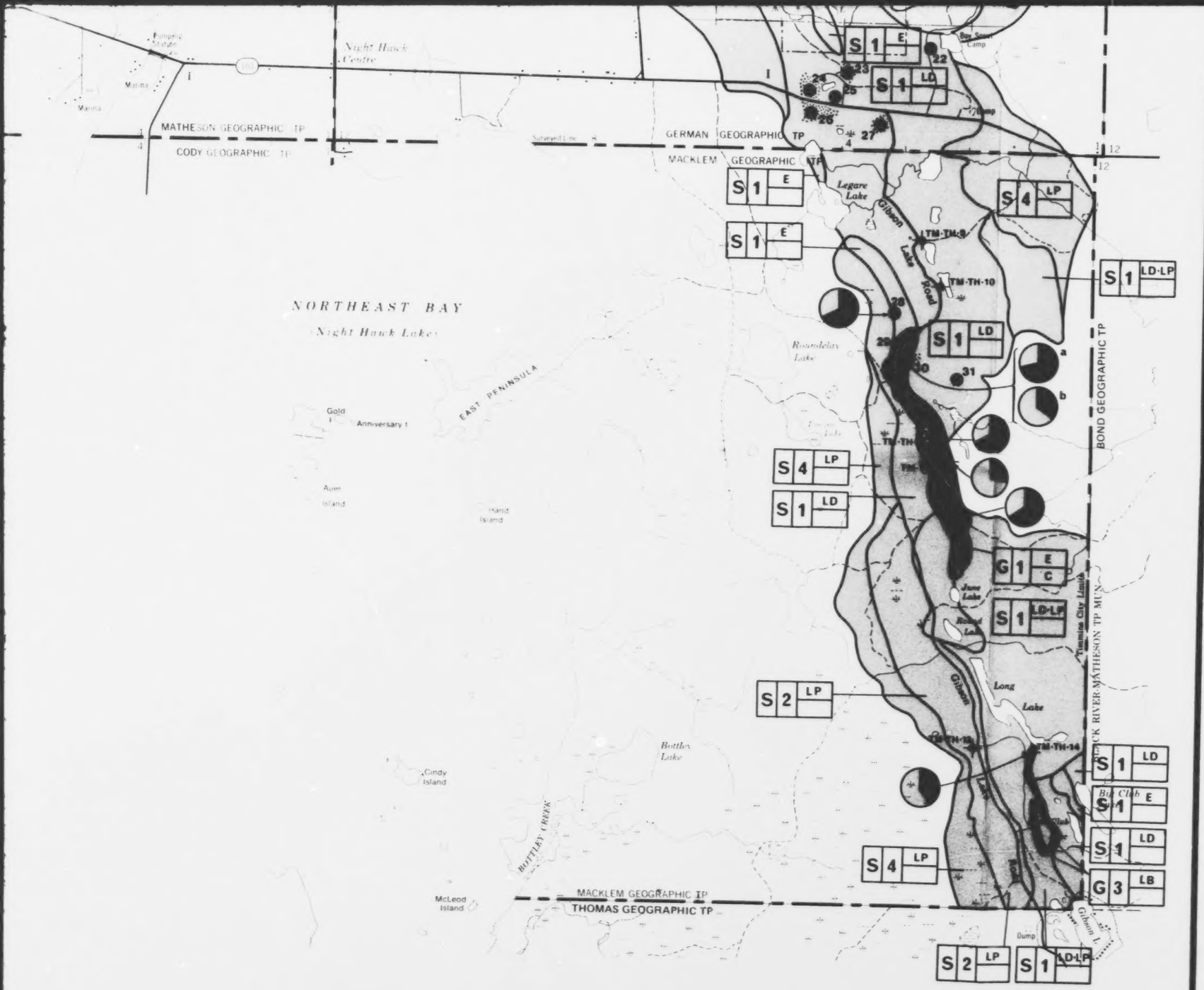
Issued 1983.

*Information quoted for an individual test hole or pit refers to a specific sample or face. Care should be exercised in extrapolating such information to other parts of the deposit.*



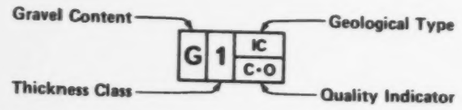

Deposit symbol see below.

Texture symbol; see below; see Figures 2,3 &4.

## TEXTURE SYMBOL

The Texture Symbol provides quantitative assessment of the grain size distribution at a sampled location. The relative amounts of gravel, sand, silt and clay in the sampled material are shown graphically by the subdivision of a circle into proportional segments. The above example shows a hypothetical sample consisting of 45% gravel, 35% sand and 20% silt and clay.

## DEPOSIT SYMBOL




Deposits are identified by Gravel Content, Thickness Class, Geological Type and Quality Indicator. Gravel Content is expressed as a percentage of gravel-sized material (i.e. material retained on the 4.75 mm sieve). Thickness Class is based on potential aggregate tonnage per acre. Geological Type refers to geologic origin. Quality Indicator describes objectionable grain size and lithology.

### Gravel Content

| | |
|---|---|
| **G** | Greater than 35% gravel. |
| **S** | Less than 35% gravel. |

### Thickness Class

| Class | Average Thickness in Feet (Metres) | Tons per Acre | Tonnes per Hectare |
|---|---|---|---|
| **1** | greater than 20 (>6) | greater than 50,000 | greater than 112 000 |
| **2** | 10 - 20 (3 - 6) | 25,000 - 50,000 | 56 000 - 112 000 |
| **3** | 5 - 10 (1.5 - 3) | 12,500 - 25,000 | 28 000 - 56 000 |
| **4** | less than 5 (<1.5) | less than 12,500 | less than 28 000 |

### Geological Type

| | | | |
|---|---|---|---|
| **AL** | Older Alluvium | **K** | Kame |
| **E** | Esker | **LB** | Lacustrine Beach |
| **EM** | End Moraine | **LD** | Lacustrine Delta |
| **IC** | Undifferentiated Ice-Contact Stratified Drift | **LP** | Lacustrine Plain |
| | | **OW** | Outwash |
| **ICT** | Ice-Contact Terrace | **WD** | Windblown Forms |

(see Appendix C for descriptions of Geological Types)

### Quality Indicator

| | |
|---|---|
| | If blank, no known limitations present. |
| **C** | Clay and/or silt (fines) present in objectionable quantities. |
| **L** | Deleterious lithologies present. |
| **O** | Oversize particles or fragments present in objectionable quantities. |

Keyson
Hoyle
Night Hawk Centre
MATHESON GEOGRAPHIC TP
CODY GEOGRAPHIC TP
GERMAN GEOGRAPHIC TP
MACKLEM GEOGRAPHIC TP
NORTHEAST BAY
Night Hawk Lake
EAST PENINSULA
Legare Lake
Rosendales Lake
Gibson Lake
Long Lake
Bottles Lake
Big Club Lake
BOTTLEY CREEK
Cindy Island
McLeod Island
Auer Island
Hand Island
Gold Island
Anniversary I
MACKLEM GEOGRAPHIC TP
THOMAS GEOGRAPHIC TP
BLACK RIVER MATHESON TP MUN.
Timmins City Limits
Gibson Road
Dump
Marina
Pumping Station
Gas Pipeline
Surveyed Line
1a
1b
4
N

J.A. Richard, 1981

Additional fieldwork by the staff of the Aggregate Assessment Office.

Terrain Evaluation by: H.A. Lee, 1979a,b,c,d.

Compilation and Drafting by: Staff of the Aggregate Assessment Office.

This map is to accompany O.G.S. Aggregate Resources Inventory Paper 90.

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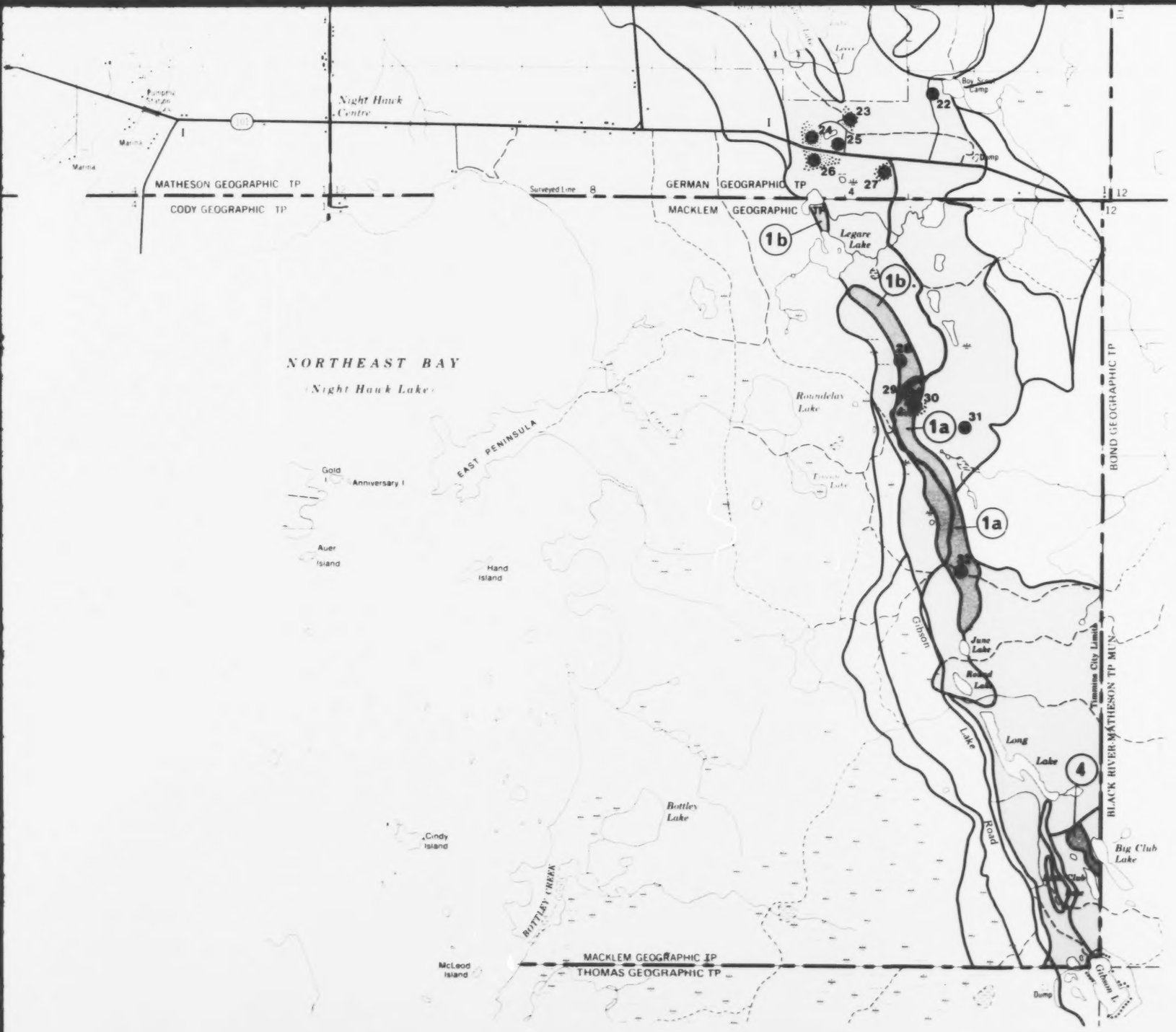
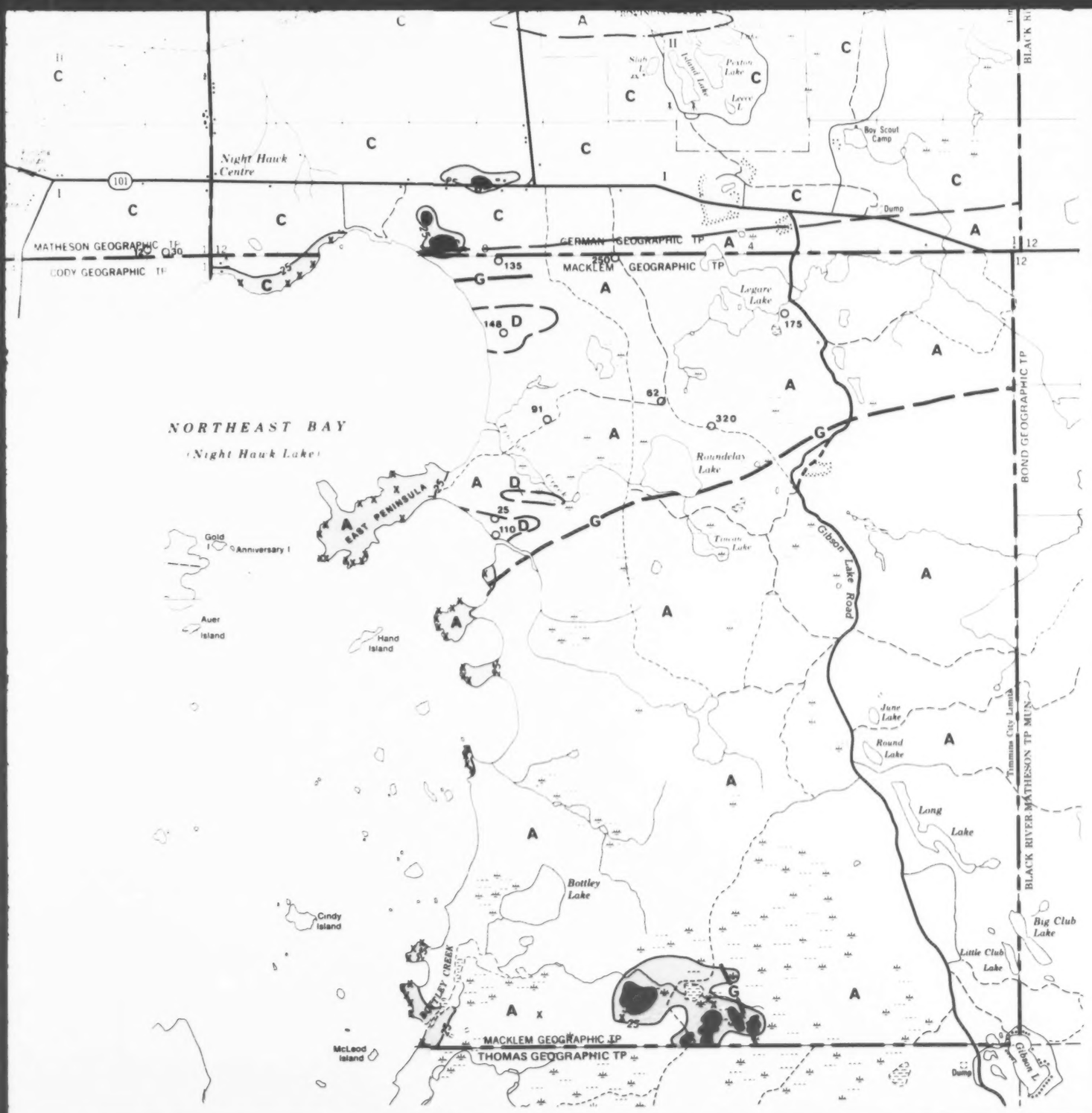
Issued 1983.



Keyson
Hoyle
Zinc Plant
Plant Dump
Sta
Concentrator
BM 964
Gas Pipeline
Dump
101
RIVER
Matheson Ck
Pumping Station
Marina
Night Hawk Centre
MATHESON GEOGRAPHIC TP
CODY GEOGRAPHIC TP
GERMAN GEOGRAPHIC TP
MACKLEM GEOGRAPHIC TP
BOND GEOGRAPHIC TP
BLACK RIVER-MATHESON TP MUN
Slab L.
Island Lake
Peston Lake
Leece L.
Boy Scout Camp
Legare Lake
NORTHEAST BAY
(Night Hawk Lake)
EAST PENINSULA
Gold I
Anniversary I
Auer Island
Hand Island
Roundelay Lake
Timan Lake
Gibson Lake Road
Junr Lake
Round Lake
Long Lake
Timmins City Limits
Bottley Lake
Cindy Island
McLeod Island
BAY CREEK
MACKLEM GEOGRAPHIC TP
THOMAS GEOGRAPHIC TP
Big Club Lake
Little Club Lake
Gilbert L
Dump
N




**Metamorphosed Ultramafic and Mafic Rocks**

D Metamorphosed Ultramafic Rocks

E Metamorphosed Mafic Rocks

**Felsic Intrusive Rocks**

F Quartz-Feldspar Porphyries

**Mafic Intrusive Rocks**

G Diabase Dikes

## SYMBOLS (Some symbols may not apply to this map)

(1) Selected bedrock resource area; deposit number; see Table 6.

Geological boundary.

25 Drift thickness contour (3 foot and 25 foot contours are shown).

Municipal, township boundary.

Q2 Quarry; identification number; see Table 5.

x Isolated bedrock outcrop.

O24 Selected drill hole location; reported depth to bedrock (in feet).

## SOURCES OF INFORMATION

Base map by Surveys and Mapping Branch, Ontario Ministry of Natural Resources.

Aggregate suitability data from the Engineering Materials Office, Ontario Ministry of Transportation and Communications.

Selected drill hole data from the Ontario Ministry of the Environment Geotechnical bore hole data from assessment file at the Resident Geologist's Office of the Ministry of Natural Resources, Timmins.

Geology by: D.S. Hunt and D. Maharaj, 1980 a,b.
D. S. Hunt, J. A. Richard and E. R. Carey, 1980.
E. J. Leahy, 1971.
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D. R. Pyke, L. D. Ayres, and D. G. Innes, 1973.
J. Satterly, 1959.

Terrain Evaluation by: H. A. Lee 1979 a,b,c,d.

Compilation and Drafting by: Staff of the Aggregate Assessment Office.

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